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NOTICE

1927 SUBSCRIPTIONS NOW DUE

Inserted in this issue of AMERICAN JOURNAL OF DISEASES OF CHILDREN *is a pink slip. It is a notification that subscriptions for the coming year are now due and payable. Those who have already paid for 1927 naturally will disregard the notice.*

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American Journal of Diseases of Children

VOLUME 33 JANUARY, 1927 NUMBER 1

CHRONIC LUNG INFECTIONS IN CHILDREN*

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INTRODUCTORY

In the whole realm of clinical medicine in children, there is probably no field which presents more difficulties than does that of disease in the chest, yet such diseases are not rarities but are brought to our notice daily. The difficulties relate chiefly to chronic, as distinct from acute, disease; for the latter has, in the main, a more violent and patent mode of expression, not only as regards the general symtoms but also as regards the local signs. Chronic infection, on the other hand, or the residue of acute infection, often presents us with the most perplexing problems in diagnosis. The doubt and confusion which often attend the interpretation of signs are dependent not only on the rather imperfect, and as yet inarticulate, methods of physical and radiologic examination, but also on certain other factors. In general terms, these factors are due to the changing expression of the same disease at successive ages, and particularly to certain anatomic and pathologic peculiarities, such, for example, as weakness of respiratory muscles and chest wall, encroachment of abdominal contents on the intrathoracic space, tendency of the lungs to collapse, etc. It is largely, therefore, from the point of view of clinical diagnosis that we propose to approach this subject, at the same time discussing the causes and effects of these infections and the ultimate and perhaps more important question of prognosis.

The practical problem, familiar alike in the outpatient department of a large hospital and in routine practice, is that of the differential diagnosis, prognosis and general management of that large class of children who are brought to us for advice on account of chronic catarrhal symptoms, e. g., persistent cough, frequent colds, repeated bronchial attacks, associated with general malnutrition and a greater or less

* Received for publication, Aug. 24, 1926.

* From the Brompton Hospital and the Hospital for Sick Children, Great Ormond Street.

amount of constitutional disturbance; in these, on examination of the chest, one frequently finds abnormal physical signs at the base of one lung. Such signs, although indicative of some departure from the normal, are often not sufficiently definite to be pathognomonic of any one clinical condition which can be correlated with the textbook or the necropsy records. In cases in which the clinical signs are general rather than local, the diagnosis of chronic bronchitis may be the only one possible; when physical signs are, on the other hand, localized in the lung, a variety of conditions may have to be considered. Clinical terms, such as chronic pneumonia, unresolved pneumonia, fibrosis of the lung, bronchiectasis, etc., represent more or less accurately certain known anatomic conditions which, as we have said, are common in one's experience of children's diseases; but the fault of the ordinary orthodox classification of pulmonary disease in children is that it concentrates too much on the purely anatomic aspect, and the main underlying pathologic principle is lost sight of in a maze of anatomic detail. It is this main principle, namely, inflammation in a general pathologic condition, which we desire to present in its relation to the various chronic infections of the respiratory apparatus in children, into the etiology, diagnosis and general management of which it is our object in this paper to inquire.

OUTLINE OF GENERAL SCHEME

Before proceeding to the detailed discussion of the pathogenesis of the various types of chronic infection, it may be well to call attention to certain examples which serve to illustrate the clinical aspect of the subject. It has been our object to discuss this question from the clinical side, and to compare our own experience with that of other observers in the endeavor to arrive at a common basis from which to approach this type of disease, and to formulate a general guiding principle in accordance with which it should be possible to lay some sort of foundation for diagnosis and for reasonable deductions as to prognosis as well as to general management and treatment in individual cases. The difficulty of acquiring exact knowledge in this connection arises largely from the fact that it is seldom possible to obtain necropsy evidence of the precise conditions in the chest corresponding to the clinical signs available at the time at which these patients come under observation. Furthermore, any statistical investigation of the clinical aspect of the subject that is to be of conclusive value must necessarily involve a prolonged search through the records of many hundreds of cases, of which but a small percentage can ultimately be traced for examination at a later date. Such observations as we have been able to make, therefore, are based mainly on clinical impressions gathered after some years of work in large outpatient departments, aided by a review of large numbers of history sheets, and the reexamination, after a period of

some years, of such a proportion of these patients as we have been able to trace. Valuable information is afforded by correlation of the history and symptomatology with the changing physical signs, and also by comparative radiologic examinations at different periods. The eight cases reported at the end of the paper have been selected from a very large number seen both in the outpatient department and in the wards in the course of the last few years, and may be regarded as more or less representative of the general clinical picture which forms the main basis of this discussion. Our object has been to try and present a short series which shall, so far as possible, show the results of chronic infections of the respiratory tract in ascending gradation according to their severity. In the first two cases there appears to have been little or no permanent structural injury to the lung; in cases 3 to 6 the evidence of structural change is greater, and in the last two still greater; case 8 is an example of the final and well-nigh incurable condition resulting because more active measures of prevention were not taken.

We are well aware that, for many of the views we have expressed, the evidence is not of that conclusive type which characterizes the anatomic or experimental investigation of disease, and that the general conclusions of this paper are, perhaps, more speculative than deductive. We believe, however, that legitimate speculation has its due place in the field of medicine, and it is with the desire to go beyond that narrower point of view in which vision of the essential causes of disease is limited by a slavish adherence to stereotyped terminology, that we have ventured to publish the following article in the hope that it may prove a live contribution to clinical thought.

ETIOLOGY

The main clinical feature of the cases reported here is the existence of a persistent chronic infective process affecting various parts of the respiratory mechanism, the pathologic changes in some instances being chiefly in the bronchial mucosa, while in others there is some evidence of structural alteration in portions of the lung itself. In many cases the previous incidence of one or more of the common acute specific fevers should be noted especially. In discussing the general etiology of this type of disease, it is necessary at the outset to call attention to the importance of a proper appreciation of the extent of the respiratory tract and to the common error, at any rate in practice, of regarding it as if it comprised only those portions extending from the larynx downward. In order to understand the causation and effects of pulmonary infections, it is desirable to remind ourselves that the respiratory tract extends from the mucous membrane of the mouth and nose to the alveolar endothelium, and that therefore no examination of the chest is complete without a thorough examination of the conditions in the

mouth, nose and throat, as well as in some instances of the nasal accessory sinuses. In dealing with the causation, symptomatology and treatment of the various conditions about to be discussed, it is essential to grasp this conception of the respiratory tract, considered functionally as well as anatomically, in order to appreciate the main underlying factor in chronic respiratory conditions in children, and the practical problem which they present.

The aspect of pulmonary disease which we now desire to emphasize is that in which it appears as the result of a long continued inflammatory process affecting the respiratory tract as a whole. According to this conception, various conditions such as bronchiectasis, fibrosis of the lung, chronic pneumonia, etc., that is to say, conditions of long standing lung infections associated with clinical evidence of basal consolidation, are regarded as results of one general pathologic process, of which the aforementioned clinical states are but the varying expression. There is little prominence given to this view in most of the literature dealing with this subject. Two instances in particular may, however, be cited. Rivière [1] refers to the permanent change which may often remain as a sequel to "an inflammation of whatever causation, in the pulmonary area, the end-results appearing as fibroid lung or simple bronchiectasis, or as some combination of both these conditions." Nobécourt,[2] in a treatise on the effects of acute bronchopneumonia in children, refers to the subacute and chronic phases ("bronchopneumonie subaigue, et bronchopneumonie chronique") as intermediate phases in what he describes as the evolution of bronchiectasis. In his clinical description he appears to regard the chronic bronchopneumonic state as more or less identical with bronchial dilatation, and he uses both terms indifferently in a way which is likely, in our view, to be somewhat misleading. His general thesis, however, is of considerable importance as calling attention to the existence of an intermediate phase in the evolutionary pathologic process, and this is of undoubted significance in the practical problem of dealing with the child at the stage at which it is commonly presented to us. Taking the foregoing observations in conjunction with our own experience, it seems to us that the general pathology and etiology of these infections and their results may be described briefly as follows:

The first stage is the commencement of a catarrhal process in some portion of the respiratory apparatus. This may occur mainly in the upper respiratory tract, and is common in the two types of "catarrhal children" described by H. C. Cameron: on the one hand, the flabby child with a high lymph content and general tendency to excess of lymphoid

1. Revière, C.: Brit. M. J. **1**:141 (Jan. 27) 1923.

2. Nobécourt, P.: Clinique médicale des enfants: Affections de l'appareil respiratoire, Paris, Masson et Cie., 1924.

tissue,[3] and on the other the thin pale nervous type, with hypersensitive vasomotor mechanism, both prone to frequent colds. Again, the infection may first occur prominently in the lower portions of the tract, often as a sequel to an acute fever (the frequency of bronchial complications after measles and whooping cough is too well known to need any special comment). From this primary infection the child may proceed, with or without a definitely recognized phase of acute bronchitis or bronchopneumonia, to the second or chronic catarrhal stage of which the essential feature is the persistence of the infective process involving any or every portion of the respiratory tract, the clinical expression of such infection varying according to its extent or localization. If the process remains chiefly in the upper respiratory tract, the clinical picture is that of the child with adenoids, with tonsils frequently infected, and an associated cervical adenitis with possible enlargement of intrathoracic lymph glands, chiefly shown by roentgen-ray examination, but without definite clinical evidence of changes in the bronchi or lungs. The persistence of this infective stage may be emphasized further by involvement of the accessory nasal sinuses, even with empyema of the maxillary antrum.

When the process is established in the lower respiratory tract, it is here that we have the main foundation for the development of the more stereotyped chronic lung diseases described in the textbook. If the infection persists, it may tend to become differentiated into either chronic bronchitis (pure), or a condition of chronic bronchitis with basal collapse and possibly some increase in the interstitial fibrous tissue, especially in the neighborhood of the bronchioles. It is here, in all probability, that the intermediate stage appears for which there is no definite clinical description, but which appears to correspond to the "bronchopneumonie chronique" of Nobécourt, the "damaged lung" of Rivière, or the condition described by Bosanquet as "resting bronchopneumonia." Out of this may result complete resolution and cure, on the one hand, with little or no resulting structural damage; or, on the other hand, fibrosis of the lung, varying in degree from slight scarring to a condition resembling chronic interstitial pneumonia, and, if the necessary putrefactive organisms are once established, the development of bronchiectasis proper.

Such, briefly, is the evolution of the "damaged lung." The occurrence of an attack on the respiratory tract by pathogenic organisms is, of course, the common lot of every child; the effects in any given person, whether transitory or permanent, mild or severe, are a question of personal immunity, and the factors which tend to lessen the resistance of the patient may be hereditary or environmental or both. Many of these children are born of parents who themselves have been prone to

3. The "adenoid" child and the child with hypertropied or unhealthy tonsils come under this heading.

diseases of the chest, having a tendency to bronchitis or to tuberculosis; not infrequently there is a family history of asthma. Among the chief environmental factors are the acute fevers, and the handicap resulting from the incidence of several of the latter within a comparatively short period is often very serious. In most of the clinical histories, the aforementioned particulars are to be obtained with general frequency, the occurrence of a definite acute bronchitis or pneumonia, and the existence of a glandular infection originating in the nose and throat being prominent in at least half the cases. Added to this must be mentioned such accessory causes of debility as rickets and other deficiency disorders, which not only contribute to the general lack of resistance associated with nutritional disorders, but in many instances are a cause of those mechanical factors in the chest to which reference has already been made, and which must be reckoned as not the least important among the general etiologic considerations.

PATHOLOGY

A brief reference must be made to the actual pathologic changes occurring in the respiratory organs as the result of inflammation; it is of some importance to know their relation to symptoms, and the summary of their effects in clinical terms. From this it may be possible to form some estimate of the anatomic conditions which may be present in the lung in those intermediate evolutionary stages of disease in which naked eye evidence is not actually available.

In acute catarrhal bronchitis, the morbid changes are for the most part confined to the mucous membrane of the bronchial tubes. Hyperemia occurs, with swelling of the lining epithelial cells and proliferation of the deeper layers, so that the whole mucosa becomes thickened, the lumen of the tubes being filled with exudate and degenerated cells. The areas of pulmonary atelectasis so often associated with the bronchitis of children appear most characteristically in those cases in which the smallest divisions of the tubes are affected, i. e., in the so-called capillary bronchitis. Clinically, the dividing line between acute bronchitis with areas of pulmonary collapse and a bronchopneumonia is by no means sharply defined, and although from the practical side, as regards treatment in the acute stage, the distinction may be somewhat academic, from the point of view of the ultimate effects on the respiratory apparatus it has a certain significance. A good deal of research, both clinical and experimental, has recently been carried out on the histology of the various types of pneumonia. The results obtained by MacCallum [4] and by others suggest that infection of the lung tissue by different organisms is attended by different types of reactions, and MacCallum maintains that

4. MacCallum, W. G.: Abt's Pediatrics, vol. 2, p. 945.

the histologic appearances can be identified with the particular organism. Broadly speaking, he recognizes two main types, namely, the interstitial and the lobular. In the former, which he regards as an expression of relatively high degree of resistance on the part of the patient, there is evidence of inflammatory changes starting in the bronchial tubes and extending along the interlobar septums and alveolar walls, and by extension through the lymphatics to the pleura; in the latter, which he associates with a lowered resistance of the tissues, there is no such evidence of barricading processes, and the infection spreads rapidly throughout the lung. The bearing of these pathologic considerations on the etiology of chronic infections of the lung and the "intermediate state" to which we have already referred is of some importance. The exact histologic condition of the injured lung in these cases must necessarily be largely a matter of conjecture, since actual evidence at necropsy is, practically speaking, never available, and one is dependent almost entirely on clinical observation. From a study of the clinical histories we are led to the belief that, when structural changes are present in the lung itself as the result of persistent infective processes, there has invariably occurred at some time or another in the history of the case an acute or subacute bronchopneumonia or as bronchitis with collapse is not of and bronchioles, has extended further, producing changes of the type of MacCallum's interstitial pulmonary inflammation. Whether the condition has, during the febrile periods, been regarded clinically as acute or subacute bronchopneumonia, or as bronchitis with collapse, is not of great moment. The point of importance, in our estimation, is that in cases in which bronchiectatic dilatation occurs, arising out of the "intermediate state," with subsequent increase of fibrous tissue and development of bronchiectasis proper, there has always been in the first instance some definite histologic change in the alveoli and interstitial tissue, without which dilatation of the bronchioles does not occur. The definition of bronchopneumonia from the histologic standpoint has always been lacking in precision to some extent. If we postulate, in cases of the less acute forms of bronchitis or bronchial catarrh, the occurrence of a condition which may be termed histologically a "bronchopneumonic state" in which microscopic changes occur similar to MacCallum's interstitial type of bronchopneumonia, some explanation is afforded of the development of more serious permanent injury to the lung in those cases in which the occurrence of a definite pneumonia is not clear from the clinical history. It is along similar lines of thought that we may find some clue as to the direction of progress in catarrhal infections of the upper respiratory tract, e. g., whether these develop into pure bronchitis or into one of the chronic pulmonary infections.

CLINICAL ASPECTS OF CHRONIC RESPIRATORY INFECTIONS

Enough has been said to illustrate the general point of view from which it is desirable to study these children in order to appreciate the principle on which we believe our judgment should depend as regards the prognosis and general management of chronic respiratory infections. It remains for us to consider the clinical aspect of the subject more in detail, and in so doing it appears to us most satisfactory to regard the evolutionary process as expressing itself broadly, so far as the results of examination of the chest are concerned, in three main aspects. In the first aspect we see the picture of chronic bronchitis (pure) of childhood; in the second, that of a fully developed bronchiectasis, the morbid anatomy of which is known, and in some instances demonstrable. In the third aspect a somewhat kaleidoscopic picture appears, representing what we believe to be that intermediate stage to which reference has already been made, in which category are to be found most, if not all, of the problems in differential diagnosis and prognosis which form the main object of this paper, and on which it has been our endeavor to throw some light. The foregoing rough division into three sections has been adopted, as it seems to permit of a more easy and comprehensive discussion of the main points of practical clinical importance. The first two groups can be dealt with briefly on the usual systematic plan; in the third, the question will be regarded mainly from the point of view of differential diagnosis and of the relation of conditions in this group to those in the other two and especially to tuberculosis. Questions of treatment are best considered in relation to all these various conditions taken as a whole from the point of view of chronic infection.

1. *Chronic Bronchitis in Children.*—Though chronic bronchitis is essentially the appanage of old age, yet it is encountered quite often in the infant and young child and presents its special characteristics in them. It is most commonly seen between the ages of 2 and 3 years, and is not common after the age of 8 or 9. In the ordinary way it is secondary to acute bronchitis, of which there has been frequently repeated attacks; more rarely it is found as a sequel to a single attack of acute bronchitis occurring as a complication of measles or whooping cough. Otherwise it appears in association with chronic infection of the lymphoid tissue of the upper respiratory tract, and in younger children gastro-intestinal disturbances seem to predispose to its occurrence. A congenital tendency is undoubtedly apparent in those patients in whom bronchitis is associated with asthmatic attacks, and also in many babies without obvious asthmatic tendency, especially those of the fat type (e. g., the lymphatic variety of Cameron's catarrhal child). Predisposing causes are chiefly rickets and chest deformities, the latter dependent on either rickets or chronic indigestion and debility from other causes. The organisms

found are mostly those of the acute variety of the disease, viz.: pneumococci, streptococci, and the bacillus of Friedländer, usually not alone but in combination.

It is unnecessary to go into details about the physical signs and symptoms of this condition, but attention may be drawn to certain of its leading features as it affects the child in contradistinction to the adult. Generally speaking, these are, first, the comparative absence of emphysema, second, the small extent to which the general health is affected, and third, the relative curability of the disease. As regards the physical signs, while emphysema is nearly always absent, in some cases in which an added asthmatic element is present, emphysema is likely to develop. The adventitious sounds are mostly of the dry type, sibilant rhonchi being audible all over the chest, but a noticeable feature is their variability from day to day. The appearance of moist sounds may be due to areas of collapse in the lung; this may cause alterations in the signs and symptoms and render their interpretation more difficult. Of the symptoms, cough is the chief one, especially in the morning, though it may be distressing throughout the night by reason of the fact that secretions are not expectorated. The cough is often hacking in character or may even be paroxysmal like that of whooping cough, and, like the physical signs, it waxes and wanes. In most cases there is no dyspnea unless the condition is complicated by extensive pulmonary collapse; as a rule there is no fever, but anorexia and general malaise occur. Once established, chronic bronchitis is likely to be interrupted by acute exacerbations characterized by cough, fever, dyspnea, and, in older children, expectoration. The condition nearly always clears up if the child is carefully treated, but treatment may have to be prolonged for months ore even years. In diagnosis the main points to be determined are, first, whether the condition is generalized and of equal intensity throughout the bronchial system, and, second, whether it is perhaps only part of another disease.

2. *Bronchiectasis.*—From the routine work of a special hospital, it would appear that the incidence of this disease in children is much larger than is generally supposed. It should be emphasized, however, that bronchiectasis is not so much a clinical entity as a pathologic condition which is either the accompaniment or the sequela of other morbid changes in the lung. The fully developed condition ordinarily described in the textbooks is but the later stage of a process that has existed for a considerable time, and the existence of bronchial dilatation in the earliest stages may be masked by the more obvious signs of the primary disease which causes it, and which for the time being forms the principal feature. The development of bronchiectasis and its differential diagnosis will be discussed more fully in the next section; we are here concerned rather in tracing the common history and etiology of those cases in children which have arrived at a stage of definite fibrosis of the lung, asso-

ciated perhaps with commencing cavitation, in which, unless the disease can be arrested at a comparatively early stage, the symptoms of increasing cough with fetid expectoration and progressive deterioration of the general health mark the advent of a serious and possibly incurable condition.

Age Incidence.—Out of a series of sixty cases analyzed by J. F. Wicht at the Brompton Hospital, twelve occurred in children between the ages of 1 and 15. It was suggested by him that this figure for the disease in children may be lower than it should be, considering the relatively small number of children's beds in the hospital. In a series published by Elliot,[5] out of forty cases only seven occurred in children, but as his patients were drawn largely from military sources the figures do not afford a true comparison. Goodhart and Still [6] conclude that bronchiectasis in children occurs chiefly between the ages of 5 and 9, twelve cases out of twenty occurring within this period.

Morbid Anatomy and Etiology.—Three main forms are described by Goodhart and Still,[6] namely, (*a*) a uniform one which they regard as the most common, in which section of the lung shows unduly large tubes, the lining membrane of which may be red or livid and in which thickening is not a marked feature; this type they consider is commonly associated with emphysematous changes and some collapse; (*b*) a saccular form in which the dilatations appear as thin walled cysts throughout the substance of the lung, this condition being of rare occurrence and thought by many to be of congenital origin; (*c*) a form in which the base of one or the other lung is contracted and the bronchial tubes widely dilated, the dilatation being neither uniform, as in *a*, nor saccular, as in *b*; this condition is generally associated with, and dependent on, a preexisting pleurisy or chronic pneumonia.

It is unnecessary to deal at greater length with the morbid anatomy of these different varieties, of which an excellent description is given by Ewart.[7] Mention must, however, be made of the acute type of bronchiectasis occasionally seen in young children and even in infants, in whom, in fatal cases of severe bronchitis, the lung is found after death to have a honeycombed appearance from the universal distribution throughout its substance of dilatations of the smaller divisions of the bronchial tubes; the onset of this condition cannot be determined clinically with any precision during life. The two main factors, be it remembered, in the causation of bronchial dilatation are weakening of the bronchial wall by disease and increase in the pressure of air within the lumen. The increase in intrabronchial pressure accompanying the paroxysms of whooping cough

5. Elliot, J. H.: M. Rec. **98**:253 (Aug. 14) 1920.

6. Goodhart, J. F., and Still, G. F.: Diseases of Children, London, ed. 12, 1925, p. 389.

7. Ewart, W.: Allbutt and Rolleston, System of Medicine, London, vol. 5, 1909.

afford some explanation of the relation between the latter disease and the development of bronchiectasis. Partial occlusion of a bronchus from any cause may lead to bronchiectasis, owing to the presence of retained secretions which undergo decomposition and set up putrefactive changes which affect the bronchial mucous membrane; thus, permanent dilatation may occur in consequence of loss of the elastic tissue in the walls. When this follows the impaction of a foreign body, the resulting bronchiectasis is often rapid in onset, and if the foreign body is of some size and any considerable length of time elapses before it is dislodged or removed, the pulmonary complications are often serious and may be fatal. By far the most common antecedent in children is some preexisting inflammation of the lung following one of the acute fevers, and more often than not this inflammatory process has taken the form of a definite pneumonia, usually of the lobular type. Reference to the history sheets shows that pneumonia or pleurisy previously occurred in about half the cases.

Clinical Features.—The principal symptom for which bronchiectatic children are brought to the hospital is cough; usually a certain amount of sputum is present, although expectoration of large quantities is not usual in the earlier stages. One of the most striking features, which is noticed quite early, is a characteristic sweetish fetor of the breath; this, in our experience, is pathognomonic of the disease even when the sputum is scanty or absent, the physical signs in the chest are very slight, and the child's general nutrition is relatively unimpaired. Hemoptysis is a symptom which should be mentioned at the outset; while this may occur at any stage, it is not infrequently an early indication, and is of the greatest importance in diagnosis. Clubbing of the fingers may appear in a slight degree before the disease has progressed to any great extent in the lung, but, as a rule, marked clubbing is observed only in the later stages when cavitation has occurred. In children in whom the condition has existed for a considerable time, in whom the expectoration is profuse and offensive, and who have begun to suffer from marked constitutional disturbance and deterioration of the general health, the picture does not differ appreciably from that of bronchiectasis in adults. The physical signs are, broadly speaking, those of fibrosis of the lung, with or without evidence of cavitation, and accompanying bronchitis. The most striking aspect of the auscultatory signs is their variability, according to the presence or absence of secretion in the lung cavities; thus, a child who shows dulness at one base with absent breath sounds on first examination may on reexamination after a fit of coughing with much expectoration reveal loud cavernous breathing and whispering pectoriloquy over the same area. The extent of adventitious sounds audible varies considerably at different times. The extent and degree of dulness depend on the amount of pulmonary consolidation. If there is extensive fibrosis, the latter may be considerable, and a large and definite area of

dulness will appear, or there also may be retraction of the lung with obvious displacement of the heart. In the earlier stages, in which the increase in fibrous tissue is not so gross, there may be little or no alteration of the normal resonance, although very light percussion may elicit a slight impairment. The earliest physical sign to be appreciated, as a rule, is a slight alteration in character of the breath sounds, the expiratory phase being unduly prolonged and the air entry diminished somewhat on the affected side. In patients in whom the diagnosis is uncertain clinically, the information afforded by radiologic examination is of the utmost value and may often be conclusive. Reference will be made to this in greater detail later.

3. *Intermediate Stage.*—We have now to consider in further detail the so-called intermediate stage of chronic pulmonary infections in which we are presented with a clinical picture which, though familiar in practice as illustrating a well-recognized general category of cases, is so far variable in regard to different persons as to make systematic description and classification almost impossible. The type is best illustrated by a reference to cases 1, 3 and 7, in which various diagnoses were made on the first occasion of seeing the patients. In a communication by one of us [8] dealing with the differential diagnosis of similar conditions, the expression "catarrhal child" was used to designate this particular class. For many reasons, this is an unsatisfactory term. Attention in these cases is usually centered on the physical signs in the chest; the practical problem is the recognition of the type of structural change and the formation of a judgment as to the probable course of events as regards a state of affairs for which the expression "damaged lung," as suggested by Rivière,[1] is probably the most appropriate. The general history and symptomatology of these patients has already been outlined, and sufficient reference made to the common sources of origin of the infective process. It is in the details of physical examination that so much variation is apparent. Apart from signs of general bronchitis, which may or may not accompany the other physical signs, there is frequently dulness at the base of one lung posteriorly, with some alteration in the character of the breath sounds. The latter may vary from a slight but appreciable diminution in air entry, with some increase of the interval between the inspiratory and expiratory phases, to very definite bronchial breathing, sometimes tubular in quality, with marked increase of the vocal resonance. As a rule, some fine râles are audible at the end of inspiration, but adventitious sounds are especially liable to variation from time to time. It is, however, frequently on account of their persistence over a long period of time that the patient is sent for to receive further opinion and advice. In addition, there may be a certain amount

8. Davidson, M.: Clin. J. **52**:437, 1923.

of deformity of the chest wall from lack of proper expansion, and consequent falling in of the lower ribs with possibly some associated scoliosis. In some of these patients there is an undoubted fibrosis of the lung following an acute inflammation, the condition being similar to the chronic interstitial pneumonia of the textbooks, seen chiefly in adults. When the abnormal physical signs are continuous with those of definite pneumonia, and the diagnosis of "unresolved pneumonia" has been made, subsequent examination after an interval of weeks or even months may reveal the complete disappearance of the signs, the lung apparently having resumed a normal healthy condition, without evidence of any permanent injury (case 5).

In a certain number of patients who when they first presented themselves had the physical signs associated with this category, the appearance of a definite bronchiectasis has been observed at a later stage in those whose subsequent progress it has been possible to observe. A point of importance in the interpretation of physical signs is the frequent occurrence of areas of pulmonary collapse; important also is the fact that fine râles audible over certain areas, particularly those corresponding to the more dependent portions of the lung, may be due simply to a condition of partial atelectasis. That small areas of collapse may occur in children in association with simple bronchitis is well known; it must be borne in mind, therefore, that the persistent dulness, together with fine râles at the base of the lung, observed in weak children who have suffered from repeated attacks of bronchial catarrh, may be due simply to the existence of such areas of collapse which may vary a good deal in extent. Reference has already been made to the importance of the histologic changes which occur in the alveoli as the result of chronic infection. So far as small areas of collapse are only the mechanical result of blocking of the bronchioles by inflammatory products, it is possible that they may, in case of the milder attacks of bronchitis, clear up with the subsidence of the inflammation and consequent reexpansion of the lung. On the other hand, when infundibular collapse has persisted for any appreciable length of time, it is likely that changes of a more permanent character do occur in the alveoli. The actual microscopic changes present in the "intermediate state," as has been pointed out, must be to a large extent a matter of conjecture, but it appears to us highly probable that the development of the more serious structural changes which lead to bronchiectasis must be preceded always by a "bronchopneumonic" state of the lung. We find it difficult to subscribe to the oft-repeated assertion that bronchiectasis may result from pure bronchitis, a view which appears to us to be insufficiently supported by accurate clinical evidence. The occurrence or nonoccurrence of the alveolar and interstitial inflammatory changes which constitute the bronchopneumonic state in association with bronchitis is doubtless a question of the relation between the virulence

of the infecting organism and the resistance of the patient. A question of considerable importance, which may well be considered here, is the possibility of localized changes in a limited area of lung resulting from the presence of an unsuspected foreign body in some portion of the bronchial tree. In medical literature, examples may be found of definite obstruction of one of the small bronchial tubes resulting from the inhalation by a child of a small particle of food during a slight choking attack while eating. The incident causes little trouble at the time and is forgotten; later on, the child is brought to the physician for persistent cough associated with symptoms of general ill-health, and a condition of localized bronchiectasis is found; in such cases the offending food particle is entirely unsuspected, and may be discovered only by direct examination with the bronchoscope. This class of case appears to be more common in America than in this country, but mention must be made of it here if only to call attention to a state of affairs which, if not of common occurrence, may yet be less of a rarity than is usually supposed. The occurrence of trouble of this kind after operation for removal of tonsils or adenoids is by no means unknown, small portions of lymphoid or other soft tissue or even blood-clot having been aspirated at the time of the operation. Attention has been directed to this subject more especially by Chevalier Jackson [9] of Philadelphia.

DIFFERENTIAL DIAGNOSIS

Broadly speaking, such is the clinical aspect of the child in the stage under discussion, who is, as a rule, brought to our notice in one of two ways—either at the end of an acute bronchopneumonic attack, when we find that the signs in the lung have not cleared up and the general health remains impaired; or else for symptoms that have not been regarded as dependent on previous illness and perhaps general in nature, that is to say, symptoms mainly of general debility and lack of nutrition associated with a greater or less degree of catarrh of the respiratory tract. In cases in which the physical signs in the chest are obvious, the diagnosis of "chronic interstitial pneumonia" is not infrequently made. While there can be little doubt that after inflammation pathologic changes do occur affecting the connective tissue framework of the lung and involving the stroma, the alveolar septums, the walls of the bronchi and of the pleura, it is better that this term should not be used unless there is quite definite and unmistakable evidence of structural alterations due to fibrosis; of these, the only certain physical sign is displacement of the heart due to retraction of the lung, and in such a case the fibrotic change is likely to be considerable. We have already noted that bronchitic signs are a fairly constant association of this type, and it is therefore important to assure ourselves that in a seemingly simple bronchitis there

9. Jackson, C.: Peroral Endoscopy and Laryngeal Surgery, Laryngoscope Co., St. Louis, 1915.

are no indications of more serious injury to the lung. Ordinarily, the presence of fluid is distinguished by the greater dulness to percussion, both in degree and extent, and by the displacement of the heart's impulse away from the dulness. It must be remembered, however, that in cases of encysted fluid or of small interlobar empyemas, the heart may be displaced toward the side of the pulmonary lesion, and in cases in which there is obvious general disturbance as evidenced by much wasting and anemia, the presence of pus in the chest is a possibility that must not be overlooked even when the occurrence of pneumonia previously is not clear.

The discussion in regard to the differential diagnosis in this class of cases would be incomplete without a reference to tuberculosis, especially since these patients are most frequently sent for further opinions because they are suspected of having this disease. It is our definite view that too many cases which really belong to this category are labeled tuberculous; in fact, it might safely be said that of all these children with cough and malnutrition who show physical signs of persistent catarrh with evidence of structural alterations at the base of one lung, a large percentage, perhaps the majority, are not, and never have been tuberculous in the commonly accepted sense of the word. The argument in support of this statement may, from our point of view, be expressed briefly as follows:

The salient feature of manifest tuberculosis in early childhood is that it is an acute and not a chronic disease. Apart from the question of the diagnosis of acute miliary tuberculosis in the first two years of life, in which condition as a rule physical signs in the lungs either are conspicuous by their absence or are merely those of generalized bronchitis, the clinical picture in children in the first decade is most commonly that of acute bronchopneumonia in which the true nature of the infection is suspected only when the fever persists long after the period at which subsidence by lysis is usually expected to take place. The suggestion, therefore, of a tuberculous origin in the subjects under discussion is based for the most part on a fundamentally erroneous conception in the minds of many practitioners as to what constitutes the typical picture of pulmonary tuberculosis in children at the elementary school age. It must undoubtedly be admitted that a careful review of the medical history sheets of many young subjects who develop signs of manifest phthisis with tubercle bacilli in the sputum during adolescence will often reveal at the period of school life a picture extending over several years which, at least in respect to general symptomatology, may correspond fairly closely with that which characterizes the nontuberculous injured lung. What then is the relation, if any, between these two chronic states, and what are the main points on which we may rely for differential diagnosis? The following clinical observations appear to us to be justified by experience:

When physical signs of fairly considerable extent at the base of one lung indicative of relative consolidation with active inflammatory changes (catarrh) of varying degree are present in a child with symptoms of chronic infection of the respiratory tract, we do not believe that such a process can be called tuberculous at this time for the following reasons: In the first place, such extensive areas of active inflammation, if tuberculous, would at this age be associated clinically with evidence of more acute or more serious illness than is actually the case; the fever would be more severe, and the presence of tubercle bacilli would be demonstrable in the sputum with greater frequency. In the second place, observation of these patients over a lung period in the hospital shows certain fairly constant features which are not, in our experience, characteristic of consumptive children. For the most part, the temperature is normal or subnormal (see charts), with slight irregular elevations to 99 or 100 F.; at long intervals there may be periods of more intense fever associated with attacks of bronchitis or bronchopneumonia of less acute type than usual. Such recurrences are against the diagnosis of tuberculosis, and do not fit in with the symptom-complex of the latter at this age.

Two qualifications may perhaps be admitted at this point: First, it is conceivable, though clinical evidence is lacking, that an acute tuberculous process might occur at this stage as a complication and so produce an acute picture; second, it is true that when fibrosis of the lung is definite and accompanied by bronchiolectasis, a secondary infection may and sometimes does occur. Attention has been drawn to the latter by Sutherland,[10] who points out that definite tuberculous pulmonary fibrosis in children is rare as judged by necropsy and clinical evidence. "Nor can it be admitted," he says, "that the finding of tubercle bacilli in the throat or sputum is positive evidence that the lung is tuberculous. In a case of chronic fibroid pneumonia there may be a secondary or superadded infection by the tubercle bacillus, just as in the case of tuberculous pneumonia there may be a secondary infection by the streptococcus or the pneumococcus."

As regards the relation between tuberculosis and the particular clinical type of disease that we have been describing, it may be considered true that while the history and general symptomatology during the first seven to ten years may be similar, the physical signs in cases of latent tuberculosis are less definite and certainly less persistent. As a rule, the earlier history of adolescent tuberculous patients shows no evidence of marked catarrhal process in the lower respiratory tract, and the case comes into the category of what has been described as "tracheobronchial adenopathy," the patient being brought to the physician

10. Sutherland, G. A.: Diseases of Children, ed. by Garrod, Batten and Thursfield, London, 1913, p. 400.

chiefly on account of general malnutrition. Although cough of a dry irritating character, occasionally paroxysmal in type, is a common symptom, the sole complaint of the parent may be that the child "doesn't get on." The question of latent tuberculosis arises, and on this subject there has been (and still is) a certain amount of controversy. Although there are undoubtedly many unrecognized cases of tuberculosis of the mediastinal glands in children, it appears to us that the incidence of this condition has been greatly exaggerated, and that much of what has been written regarding hilum tuberculosis in the child is unsupported by definite evidence. One of the best statistical investigations is given by Chandler and Preston,[11] who reported on nearly 300 cases diagnosed as pulmonary tuberculosis, but of these only 89 (29.6 per cent) children were proved by them to be definitely tuberculous, either by finding tubercle bacilli in the sputum, by necropsy or by both. These authors regard the unproved cases in their series as being in all probability early cases of pulmonary or possibly hilum tuberculosis, and they criticize the statement that pulmonary tuberculosis in children is a rapidly fatal disease on the ground that it is not wholly true, their view being that more chronic forms of pulmonary tuberculosis infection do occur with considerable frequency in childhood. We would point out that of all the factors which have to be taken into account in this connection as bearing on the question of differential diagnosis, one of the most important is age incidence. From what has already been said in regard to the etiology of the common catarrhal infections of the respiratory tract as well as from the curves obtainable of the incidence of bronchitis and bronchopneumonia in children, it is clear that the age of onset of these infections is, roughly speaking, between 2 and 5 years. In the eighty-nine cases of proved tuberculosis detailed by Chandler and Preston, the youngest child was 3 and the oldest 15 years; the average was 11.8 years, a considerable proportion of the children being above this age. In other words, the authors appear to rely for proof of their contention to a large extent on the fact that the greater proportion of their patients were children who had advanced well into the second decade of life, at which period the incidence of apical phthisis of adult type is recognized to be much higher. We do not wish to proceed further in a controversial matter; our main point is that in the great majority of children with catarrhal symptoms and definite abnormal physical signs at the base of one lung, the diagnosis of pulmonary tuberculosis is not justified unless tubercle bacilli are demonstrated either in the sputum or in the feces. The value of Pirquet's cutaneous tuberculin reaction is seen chiefly in those cases in which a negative result is obtained in young children. The view

11. Chandler, F. G., and Preston, T. W.: Brit. J. Child. Dis. **22**:1, 1925.

taken by Watt [12] that many debilitated children suspected of having tuberculosis but without clinically demonstrable evidence of this disease are subjects with primary infection developing immunity is one with which we are strongly inclined to agree, although we deprecate the view that such patients should be classified as having cases of early pulmonary or hilum tuberculosis.

SCHEME OF EXAMINATION AND PROGNOSIS

In approaching the case of a child with a history of chronic cough, general ill health and abnormal physical signs marked at the base of one lung, the examination must be systematic and in the first place must involve a detailed and very complete account of the previous medical history, with special reference to the occurrence of any acute fevers. If there has been more than one of these, attention should be paid to the intervals between them, having regard to the serious effects in so many cases of the incidence of several fevers in quick succession. While measles and whooping cough are the two diseases of primary importance from their well-known liability to pulmonary complications, it not infrequently happens that the addition of scarlet fever, chickenpox or diphtheria has increased the child's handicap by further lowering the general powers of resistance. This may be one of the points which have to be reckoned in estimating prognosis (case 8). The occurrence of a single definite attack, or still more of successive attacks, of pneumonia is significant as suggesting the probable existence of fibrotic changes in a lung, especially when the question of early bronchiectasis is under consideration. The family history should be ascertained and note taken of any unusual prominence of asthma, bronchitis, etc., in parents or in near relations, this being a point not without significance. Once more, in relation to what has already been said on the subject of tuberculosis, the family history is of undoubted importance. It must be remembered that in any subject in whom, by reason of lack of immunity, heredity or environment, active tuberculosis does manifest itself in the lung during adolescence, any injury to this organ sustained in the earlier period of life may well be regarded as one of the important contributory factors. Consequently, in dealing with a delicate child in whom the integrity of the respiratory tract is a subject of investigation, a bad family history, namely, the death of several near relatives from undoubted tuberculosis, should always be looked on with gravity. Apart from the question of tuberculosis, we feel that the prognosis, given suitable environment, is, on the whole, reasonably good. In the majority of instances in which the child is kept under healthy, open air conditions, suitably fed, not overworked either physically or

12. Watt, J. A.: Lancet **2**:1327 (Dec. 27) 1924.

mentally, and every effort made to avoid so far as possible the incidence of fresh infections, the symptoms will disappear, the general health will return to the normal standard, and the abnormal physical signs, at any rate in a large proportion of cases, will entirely clear up. A point on which it is, perhaps, desirable to insist is that too much importance should not be attached to physical signs alone. In estimating the value of such signs as may be present and in forming a judgment as to prognosis, it is essential that the whole symptom-complex be taken into account.

The physical examination should comprise routine observation of the general condition, and then examination of the chest with subsequent careful examination of the mouth, nose and throat. The configuration of the chest is important and should be noted; such points as sinking in of the lower ribs, pigeon-breast and Harrison's sulcus, often associated with nasal obstruction, are well known and usually sufficiently obvious. Relative dulness at the apexes of the lungs is a common feature, and frequently means no more than narrowness and deficient expansion from inadequate air entry, especially in children who are inclined to mouth breathing. Asymmetry of the chest, however, may be of importance, and a moderate degree of fibrosis in a lung, though insufficient to cause marked retraction with obvious displacement of the heart, may nevertheless show itself in a slight flattening of the chest on one or the other side with diminished movement during inspiration. As has been pointed out, the occurrence of fine râles may indicate a persistent active catarrh or may simply be associated with a certain degree of collapse. It is important in auscultating to separate in one's mind the presence of adventitious sounds from the character of the breath sounds, and to determine these two factors independently. Too much emphasis is often laid on the mere presence or absence of adventitious sounds, alteration in the character of the respiratory murmur being probably of great importance as evidence of structural change in the underlying lung. The persistence, however, of adventitious sounds for very long periods, say twelve months or more, gives them an altered significance. As regards examination of the upper respiratory tract, while complete investigation is the province of the special department, the physician must obviously have sufficient general acquaintance with the work of his surgical colleague to appreciate its bearing on his own clinical observations. Tonsils which give rise to trouble in this connection are not by any means always obviously enlarged, and are often of the type in which the greater part lies buried beneath the surface. Occasionally, thin pus can be expressed from the crypts. As regards the condition of the postnasal space, trouble due to adenoid growths is by no means confined to those children in whom there is gross and obvious evidence of nasal obstruction. The presence of

enlarged cervical glands is of importance and especially of small shotty glands in the posterior triangle of the neck. Deflection or thickening of the nasal septum or hypertrophic rhinitis may occur in children, with consequent blocking of secretions, conditions which call for special treatment; cases are on record of children suffering from chronic paroxysmal cough which has yielded immediately to treatment by washing out the maxillary antrum which was found to be full of pus.

The value of radiologic examination cannot be overestimated, but, it must be added, for anything like an adequate appreciation of what really constitutes roentgen-ray evidence, the work of the clinician and that of the radiologist must go hand in hand. We would protest alike against the indiscriminate diagnosis of tuberculosis in children on roentgen-ray observations entirely unsupported by clinical evidence, and against the acceptance by clinicians of poorly understood conceptions of the significance of linear shadows in a roentgenogram. Many clinicians never see the roentgenograms of patients, nor have they any cognizance of the conditions under which the roentgenogram has been taken, or of the variations normally obtainable with different types of tubes, to say nothing of the distortions which may be produced by faulty centering. In those cases in which from the clinical evidence the condition of dilatation of the bronchioles is suspected, one of the most important pieces of information is that supplied by screen examination as to the relative mobility of the diaphragm. When there is a certain degree of fixation, or restriction of movement, especially in a patient who gives a definite history of pneumonia previously, the whole matter of diagnosis and treatment may turn on the radiologic reports. In very early cases of bronchiectasis the value of the injection of iodized oil 40 per cent is inestimable, not only for diagnosis in unilateral disease, but for determination of the exact condition of the opposite lung when the question of collapse therapy by means of collapse is under consideration.

Into the details of the treatment of this class of patients we do not propose to enter, but a few words are necessary as to the general principles which should guide us in the management of cases. In the first place, having regard to what has been said on the subject of etiology, we would again urge the importance of thorough examination of the upper respiratory tract in all cases of chronic pulmonary conditions which do not yield to ordinary simpler remedies, and, indeed, it may be said, in every instance in which systematic examination of the chest is indicated. It is surprising to note how often a child has been examined and treated for persistent cough by numerous clinicians, not one of whom has ever looked at the throat. We cannot lay too much emphasis, first, on the necessity of discovering and dealing with any septic focus which may be present in this region as a preliminary to further measures; second, as regards the environment of these patients, since it is obviously of

importance to raise their power of resistance to infection by any and every means possible, the adoption of a regimen similar to that generally recognized in the treatment of active tuberculosis is equally applicable to the types of disease which we have been considering here. To send these children for a few weeks to the seaside is often little more than a palliative, and we would urge the adoption, whenever circumstances render it possible, of the sanatorium type of life for prolonged periods. The value of ultraviolet irradiation has been more fully recognized of late, and has proved of inestimable benefit to many children of this class in the large towns, who cannot be sent to the country for any appreciable length of time. Finally, we would mention the advances in the last few years of modern mechanical methods in the treatment of intrathoracic disease. For the technical details of treatment by artificial pneumothorax, evulsion of the phrenic nerve and extrapleural thoracoplasty, reference must be made to the various textbooks dealing with these subjects; but it must be remembered that these methods have undoubtedly a certain scope as applied to the subject of this paper, especially in those more advanced results of pulmonary inflammation in which the trouble is perpetuated by reason of the existence of various mechanical factors without removal of which no treatment is likely to effect a permanent cure.

CASE REPORTS

CASE 1.—H. G., a boy, aged 6 years, was admitted to the hospital, April, 1913, on account of cough and loss of weight of about six months' duration. The patient coughed chiefly in the morning; there was a fair amount of yellow sputm, some shortness of breath and occasional pain in the chest with the cough. The previous illnesses were measles, whooping cough and chickenpox.

Family History.—The patient's father and mother were alive and healthy; two other children were also both alive and well.

On admission to the hospital, slight impairment of resonance at the base of the right lung behind and over the middle zone in front and in the axilla was noted; there were slight general bronchitic signs (rhonchi) on both sides and a few fine moist râles at the right base behind. The breath sounds were harsh (puerile) in character, and more bronchial in type on the right side. The tonsils were enlarged.

The roentgen-ray report, May 15, was as follows: "Thickening and opacity at the roots of both lungs. Enlargement of bronchial glands (?)."

The patient was kept in the hospital for six weeks; there was slight irregular fever of the type shown in chart 1. The physical signs in the chest were persistent, and were always more marked on the right side. After an operation for removal of the tonsils and adenoids, the child was sent to a convalescent home.

In 1922, at the age of 15, this patient was seen in the outpatient department. His general condition was good; he had no cough or other symptoms, and the physical signs in the chest appeared normal.

A roentgen-ray examination, June 22, 1922, showed no abnormality.

CASE 2.—S. W. R., a boy, aged 3 years, 9 months, was admitted, February, 1911, for cough intermittent ever since birth. The patient had chickenpox shortly before admission; there were no other illnesses. The family history was not recorded.

On admission, the percussion note was impaired at the base of the right lung; there was some general bronchitis on both sides; sharp râles were audible, especially over the whole of the right side. Sputum (obtained by irritating the pharynx with a swab to excite cough) showed no tubercle bacilli. The Pirquet reaction was positive.

This patient remained in the hospital for seventy-three days. For some weeks a slight irregular fever persisted, as in case 1, and the bronchitic signs continued, always more marked on the right side. The diagnosis of bronchiectasis was suggested at the time. There is no record of what happened to this child when he left the hospital, but he was traced in 1922, and came to the outpatient department for examination.

August, 1922, the patient's general condition was good; no definitely abnormal physical signs were noted in the chest; the percussion note at the bases of both lungs was somewhat hyperresonant (?). The patient's mother said that he was inclined to colds and bronchitic attacks in the winter, but, on the whole, he was fairly well and able to play ordinary outdoor games.

There apparently was no roentgen-ray examination made of this patient.

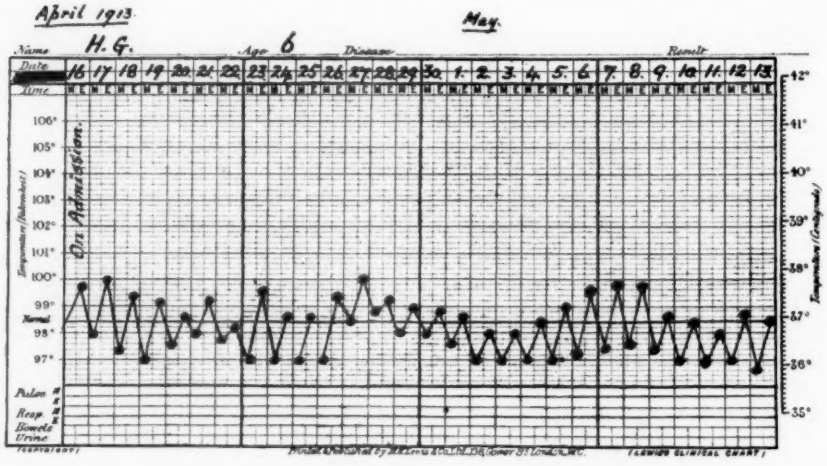

Chart 1 (case 1).—Temperature chart of H. G.

CASE 3.—G. C., a boy, aged 7 years, had been attending various hospitals on account of cough.

He was admitted to the hospital, May, 1913, with the report of cough, wasting, night sweats and occasional pain beneath the sternum.

His past illness consisted of measles at the age of 2 years, 6 months. The family history was not recorded.

On admission, the percussion note was impaired in the lower part of the right axilla and at the base of the lung behind; a few sharp râles were audible in the axilla, and were faintly audible behind, below the angle of the scapula.

The roentgen-ray report, May 28, was as follows: "Right side of the diaphragm is practically immobile; the heart (?) is displaced to the right; the lower third of the right lung is patchy and opaque, suggesting irregular consolidation; increased opacity at the roots of the lungs is present; unresolved bronchopneumonia (?).

The patient remained in the hospital for fifty days, the dulness and crepitations persisting at the right base and the temperature chart showing the same type of slight irregular fever as in cases 1 and 2. On discharge the provisional diagnosis was right pleurisy (?); resting bronchopneumonia (?).

The patient was traced and brought to the outpatient department in 1922, at the age of 16.

Examination showed that the general condition was fairly good, with poor chest development; there was some impaired resonance, especially at the right apex, with irregular jerky breathing (cogwheel type); there were no physical signs of any active catarrh; the boy complained of no symptoms, and was able to do his work without trouble.

CASE 4.—E. J., a boy, aged 10 years, was brought to the outpatient department, September, 1920, with a note from his physician, who sent him for advice because of persistent physical signs at the base of one lung.

History.—Five years previously the patient had had an attack of measles, followed by bronchopneumonia; since then he had suffered from frequent bronchial attacks, general weakness, malnutrition and occasional night sweats; his physician suspected tuberculosis, although there was no tuberculosis in the family history.

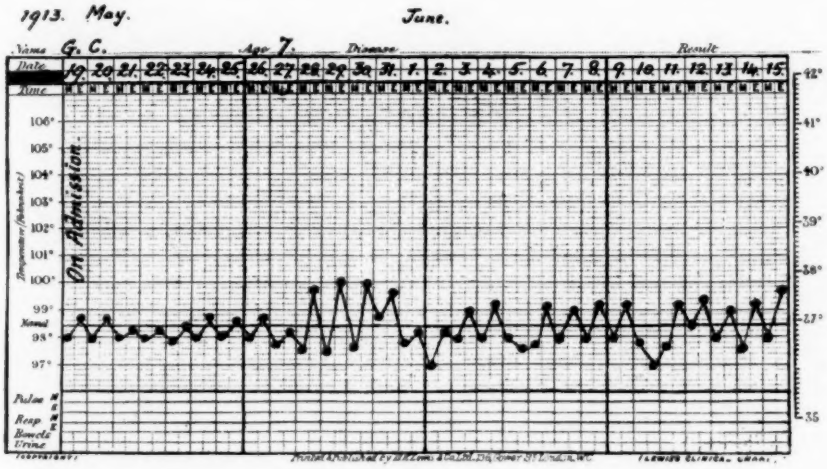

Chart 2 (case 3).—Temperature chart of G. C.

Examination showed that the general condition was poor; the boy was thin and ill-nourished; slight scoliosis was present; there was no enlargement of the cervical glands; there was a suggestion of cyanosis (the face appeared slightly dusky).

There was very definite dulness at the base of the left lung below the angle of the scapula, in which persistent crepitations were audible on inspiration; the adventitious sounds were unaffected by coughing. Elsewhere in the chest the physical signs were normal.

The roentgen-ray report, September 13, was as follows: "Apexes are clear and expansion is good; heavy hilum shadows; suspicious mottling of right upper lobe.

This patient was treated for a time in the outpatient department, and was finally sent to the country to live on a farm for six months.

March, 1921, he was again seen and examined. His general condition was much improved; no abnormal physical signs were found in the chest; a second roentgenogram was obtained which was similar in appearance to the first, but the hilum region showed certain opacities which were harder and more clearly defined and suggested the presence of calcified glands.

CASE 5.—D. B., a girl, aged 12 years, was admitted to the hospital, July, 1925, complaining of cough of some years' duration, frequent colds and loss of appetite.

Past History.—Two years previously the patient had been examined clinically and radiologically at a general hospital, and was said to have "collapse of the base of the lung." In December, 1924, she had had a febrile attack described by her mother as influenza; since then she had been generally out of sorts.

On examination, the child weighed 5 stone (70 pounds). The temperature was 100 F., the pulse 100. There was marked dulness at the lower part of the right lung behind, from the inferior angle of the scapula downward, with intense tubular breathing and bronchophony; there were no adventitious sounds; the signs suggested a pneumonic type of consolidation; there was no increase in the frequency of the respirations.

The roentgen-ray report, August 5, was as follows: "The heart and mediastinum are drawn to the right side; the diaphragmatic movements are free; impaired translucency at right base, and exaggeration of basal linear striation are present."

During the seven weeks or so that the child was in the hospital, no symptoms of any moment were observed. The temperature showed occasional slight elevations, but was never over 99.4 F. Radiologic examination after intratracheal injection of iodized oil 40 per cent, which outlined the bronchial tree on the right side, showed no indication of any dilatation of bronchi.

The roentgen-ray report, August 31, read: "Iodized oil 40 per cent in right base; this appears to be one of the most normal cases we have had."

The patient was discharged to a convalescent home, with the diagnosis of fibrosis of the base of the right lung.

On December 16, she was again seen in the outpatient department, three months after her discharge from the wards. She had gained 12 pounds (5.4 Kg.) in weight, had no symptoms, and looked and felt well.

On examination, the physical signs in the chest were normal, the breath sounds being vesicular in character and the dulness at the base of the right lung having completely cleared up.

CASE 6.—J. B., a boy, aged 12 years, was brought to the outpatient department, June, 1920, complaining of an intermittent cough for some years. The past illneses were measles followed by pneumonia at the age of 4.

Family History.—The patient's father and mother were alive and well. There was no history of tuberculosis in any member of the family.

On examination, the general condition was good; there was slight impairment of resonance at the base of the left lung behind, where fine crepitations, unaffected by coughing, were audible during inspiration; the breath sounds were harsh (puerile type) all over the chest; there was no definite bronchial breathing.

The roentgen-ray report, Jan. 1, 1921, was as follows: "Calcareous glands at the hilum; exaggeration of linear radiating shadows suggesting chronic irritation, most marked at bases; no definite evidence of infiltration of lung tissue."

This patient attended the outpatient department at intervals for treatment, and had an operation for removal of tonsils and adenoids. On examination two years later (Sept. 23, 1922) he still had slight impairment of resonance at the left base, where the breath sounds were harsher and more bronchial in character than on the right side; occasional crepitations were still audible. His general condition was excellent, and since removal of the adenoids and tonsils he had lost the cough, and was better in health altogether.

CASE 7.—V. H., a girl, aged 7½ years, was brought to the outpatient department in April, 1926, with the complaint of "not getting on," loss of appetite, failure to gain weight, etc. For two or three years she had had a cough, which had been worse during the winter, with fair amount of yellow sputum, mostly coughed up the first thing in the morning.

The patient's past illnesses were: pneumonia, four attacks at different times; measles; frequent colds.

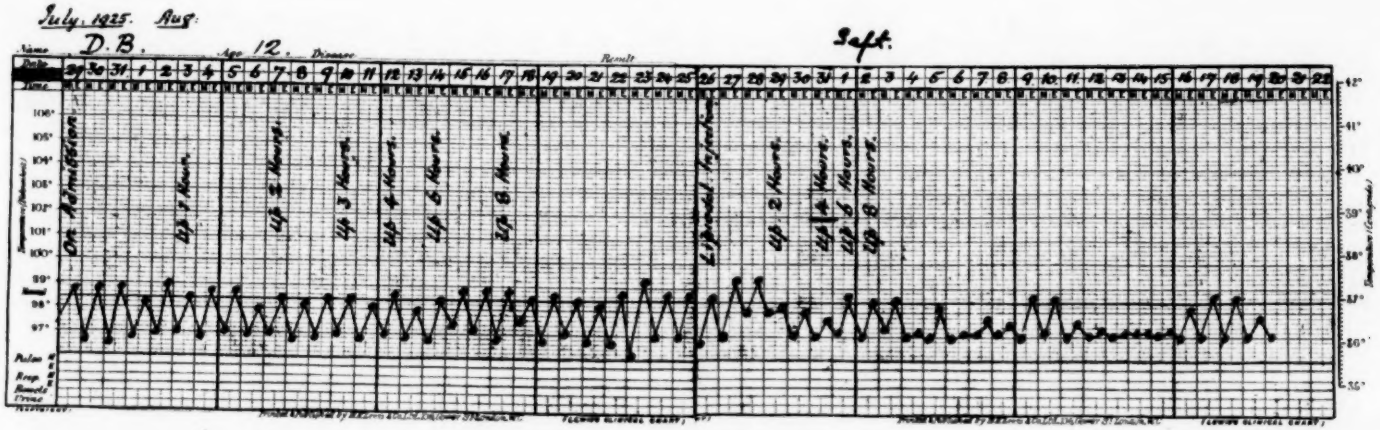

Chart 3 (case 5).—Temperature chart of D. B.

Family History.—The child's father and mother were healthy; two other children were alive and well.

Examination showed a pale, very thin child, who was much under normal size for her age, but mentally bright; there was no clubbing of the fingers. The percussion note in the chest was unaltered (normal resonance); some rhonchi were audible at the bases of the lungs on both sides; the breath sounds were harsh and expiration was prolonged; physical signs were rather more marked on the left side where the breath sounds were more definitely bronchial in character than on the right; increased vocal resonance above the spine of the left scapula was noted.

The roentgen-ray report was as follows: "Peribronchial thickening of both bases and some dilatation of bronchioles are present; bronchiolectasis (?); appearance atypical."

CASE 8.—J. E. H., a girl, aged 5¾ years, was brought to the outpatient department in December, 1922, on account of wasting and cough for two years; the cough had been worse since an attack of pneumonia and the patient was expectorating about half an ounce of sputum daily. The past illnesses were measles followed by whooping cough, pneumonia in 1920, chickenpox during convalescence from the pneumonia, scarlet fever in January, 1921 (in the hospital for three months).

On examination the temperature was 100.4 F., pulse 130. The general condition was poor; the child was pale and thin and weighed 2 stone, 13 pounds (41 pounds). The cervical glands were slightly enlarged; some remnants of tonsil were seen on examination of the throat. There was impaired resonance of the chest, with a few fine râles on inspiration at the base of the left lung behind. The condition was diagnosed as "basal collapse of the left lung after pneumonia"; the patient was admitted to the hospital, and after ten weeks was discharged to a convalescent home.

June 20, 1923 (after the patient's return from the convalescent home), the physical signs at the left base were much the same, but there was definite diminution of breath sounds. On June 30, hemoptysis was fairly severe, half a pint being the estimated loss. The patient was admitted to the hospital again with a diagnosis of bronchiectasis at the left base and remained in the hospital for seven weeks.

March 26, 1924, the physical signs at the left base were much more marked; dulness with coarse râles and cavernous breathing were present. The patient had had three hemorrhages since July, 1923, and the question of artificial pneumothorax treatment was submitted to the parents, who were, however, unwilling to allow this to be done.

Jan. 24, 1925, the patient was again admitted, the father then being willing to allow any treatment to be carried out, but pneumothorax treatment could not be contemplated as both clinical and roentgen-ray evidence showed extensive disease on both sides.

TREATMENT OF ACUTE POLIOMYELITIS WITH POLIOMYELITIS ANTISTREPTOCOCCUS SERUM

RESULTS FROM 1921 TO 1925 *

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Studies on the filtrable virus of poliomyelitis, while invaluable as regards etiology, have yielded little of specific therapeutic importance except perhaps the serum from convalescent patients. Although the value of this serum is still a debated question, it seems to have beneficial action in some instances, especially if given in large amounts.[1] In others, no apparent benefit follows its use.[2] Some warn against its intraspinal injection [3] and, while it usually has viruscidal power in vitro, the treatment of the disease produced experimentally in monkeys under controlled conditions is not always successful.[4] Even though it had undoubted curative effects, the practical difficulties would always prevent its universal application in the treatment of this disease.

One of us has previously reported on the value of an antistreptococcus serum in the treatment of acute poliomyelitis.[5] The results from

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* From the Division of Experimental Bacteriology, The Mayo Foundation.

1. Amoss, H. L., and Chesney, A. M.: A Report on the Serum Treatment of Twenty-Six Cases of Epidemic Poliomyelitis, J. Exper. Med. **25**:581, 1917. Bolt, R. A.: Poliomyelitis in Cleveland in 1917, Cleveland M. J. **17**:156, 1918. Netter, A.: Un cas de myélite aiguë diffuse guérie par les injections intrarachidiennes de sérum de sujets antérieurement atteints de paralysie infantile; sérotherapie de la polimyélite antérieure, Bull. de l'Acad. de méd. **81**:525, 1914. Zingher, Abraham: The Problem of After-Care, Arch. Pediat. **33**:872, 1916.

2. Schwartz, A. B.: Society Report, Arch. Pediat. **33**:859, 1916.

3. Draper, George: Acute Poliomyelitis, Philadelphia, P. Blakiston's Son & Co., 1917, pp. 149; Serum for Infantile Paralysis, J. A. M. A. **85**:995 (Sept. 26) 1925. Emerson, Haven: A Monograph on the Epidemic of Poliomyelitis in New York City, New York City, Department of Health, 1917, p. 285. Peabody, F. W.: A Report of the Harvard Infantile Paralysis Commission on the Diagnosis of Acute Cases in 1920, with Special Reference to the Incidence of Cases Without Paralysis, Boston M. & S. J. **185**:174, 1921.

4. Abrahamson, H. L.: Collected Studies, Bureau of Laboratories, City of New York, 1916-1919, p. 114.

5. Rosenow, E. C.: Report on the Treatment of Fifty-Eight Cases of Epidemic Poliomyelitis with Immune Horse Serum, J. Infect. Dis. **22**:379, 1918; Treatment of Acute Poliomyelitis with Immune Horse Serum: Further Studies, J. A. M. A. **71**:433 (Aug. 10) 1918; Treatment of Acute Poliomyelitis with Immune Horse Serum: Summary of Results, J. A. M. A. **77**:588 (Aug. 20) 1921.

personal observations as well as those by others were so striking as to confirm its value in the limited number of cases treated, and to furnish evidence of the importance of the streptococcus in the production of symptoms.

The antistreptococcus serum does not always manifest viruscidal action in vitro or invariable protective action in experimental poliomyelitis in the monkey. The streptococcus used for the preparation of the serum, while it tends to produce flaccid paralysis in the rabbit, does not produce typical poliomyelitis in the monkey, the rabbit being highly susceptible and the monkey highly resistant, whereas with the virus the conditions are reversed, the rabbit being highly resistant and the monkey highly susceptible. Hence, much skepticism still exists as regards the importance, in the etiology of poliomyelitis, of the streptococcus with which the serum is prepared. It is beyond the scope of this paper to discuss all of the evidence which has been adduced as regards the importance of this streptococcus; suffice it to state that by proper methods it is demonstrable in infection atria [6] and in the lesions in brain and cord,[7] and that with it a disease resembling infantile paralysis can be produced in rabbits and guinea-pigs.[8] With freshly isolated strains, antigens have been prepared, from which, when injected intradermally in children who have not had poliomyelitis, a marked local reaction usually occurs, while in those who have recovered from undoubted attacks the reaction is negative, or only slightly positive. The serum used in treatment has the power to neutralize the toxic effect of these antigens.[9]

Poliomyelitis varies so greatly in its manifestations in individual cases and in different epidemics, and the number of cases seen by the general practitioner is usually so small that he is not always able to have reliable judgment regarding prognosis and the value of any therapeutic measure. The need for someone to prepare and study the effect of this serum in a large number of cases occurring sporadically and in different epidemics, particularly under field conditions, became apparent during the earlier studies. This has been done through the beneficence of the Mayo Foundation, and in this paper we wish to report on the method of the preparation and use of poliomyelitis antistreptococcus serum, and

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6. Nicoll, Matthias, Jr.: The Epidemic of Poliomyelitis in New York State in 1916, New York State J. M. **17**:270, 1917.

7. Hektoen, Ludvig; Mathers, George, and Jackson, Leila: Microscopic Demonstration of Cocci in the Central Nervous System in Epidemic Poliomyelitis, J. Infect. Dis. **22**:89, 1918. Rosenow, E. C., and Wheeler, G. W.: The Etiology of Epidemic Poliomyelitis, J. Infect. Dis. **22**:281, 1918.

8. Rosenow, E. C.; Towne, E. B., and Hess, C. L. v.: The Elective Localization of Streptococci from Epidemic Poliomyelitis, J. Infect. Dis. **22**:313, 1918.

9. Rosenow, E. C.: A Specific Precipitin Reaction in Epidemic Poliomyelitis, J. A. M. A. **84**:429 (Feb. 7) 1925.

to analyze the results obtained in cases seen with family physicians by one or both of us during two epidemics, and in cases reported to us by physicians to whom the serum was sent on request for study.

PREPARATION AND USE OF THE SERUM

The serum used was from horses that had been immunized by the injection in increasing amounts of, first, the dead and, second, the living pleomorphic streptococcus isolated from patients with poliomyelitis. The exact procedure, the source of the culture, the method of preserving specificity of the streptococcus, the interval between injections, the duration of the period of immunization and the nature of the antigen have been changed from time to time, as our knowledge regarding its effect in treatment and its agglutinin and precipitin content increased.

In previous publications, it has been repeatedly emphasized that the pleomorphic streptococcus of poliomyelitis which appears to have etiologic significance often loses its specificity promptly on artificial cultivation.[10] In order to prepare curative serums, therefore, it is important to use for immunization strains freshly isolated from patients with poliomyelitis or from the brain and cord of monkeys that died following the inoculation of virus. The serum used during 1917 was prepared in this manner. The seasonal variation in the incidence of poliomyelitis, the expense of passing virus successively through monkeys and the difficulty experienced in isolating the streptococcus, particularly from the brain and cord of monkeys paralyzed by the adapted virus, and the long period of immunization necessary for the production of suitable serums make this method impracticable. Since the streptococcus, as well as the virus, was found to live for a long time in brain and cord preserved in 50 per cent glycerol, it occurred to one of us that glycerol might preserve the viability and specificity of freshly isolated cultures of the streptococcus. We have since learned that this is true. Viability and specificity of the streptococcus may be preserved for a long time by making dense suspensions in 50 per cent glycerol, or preferably in two parts glycerol and one part saturated sodium chloride solution in water. The serum used in the treatment of the cases included in this series was prepared almost entirely by intravenous injections of the streptococcus preserved in dense suspensions of glycerol sodium chloride solution. Great care was exercised in selecting the strains of the streptococcus for immunization. Only those strains were considered suitable which, on isolation, possessed typical morphologic and cultural characters, which were agglutinated specifically by heterologous serums or whose

10. Rosenow, E. C., and Gray, Hazel: Agglutination of the Pleomorphic Streptococcus Isolated from Epidemic Poliomyelitis by Immune Horse Serum, J. Infect. Dis. **22**:345, 1918.

extracts in sodium chloride solution gave a specific precipitin reaction and which produced flaccid paralysis in rabbits following intracerebral inoculation. The strains from infection atria were usually obtained as follows:

The nasopharynx in acute cases was swabbed with a curved wire, the distal end being wrapped with absorbent cotton, and care was taken to avoid contamination from the tongue. The swab was washed in 2 cc. of sodium chloride or (0.1 per cent) gelatin Locke solution. Two rabbits were then inoculated intracerebrally under ether anesthesia, one with 0.1, the other with 0.2 cc. of this suspension, or with the primary twenty-four hour glucose brain broth culture of the suspension. If one or both animals developed flaccid paralysis, and the streptococcus isolated from pipettings containing cerebrospinal fluid and brain and cord substance produced greenish colonies on blood agar and agglutinated specifically in hyperimmune serum, this strain was considered suitable for immunization. The strains isolated from brain and cord emulsions or filtrates thereof from fatal cases or monkeys paralyzed with virus were considered suitable if cultural and agglutinin reactions were typical, or if flaccid paralysis developed in inoculated rabbits. In some instances, the latter requirement was not considered a prerequisite because the virulency of these strains, especially those from monkeys, was not always sufficient to produce paralysis in rabbits. Pure cultures obtained from blood agar platings of the streptococcus, preferably of the primary cultures from the nasopharynx or from the brain of paralyzed rabbits in glucose brain broth, were inoculated into glucose brain broth. These were incubated overnight at 35 C., and the growth thus obtained was used to inoculate large bottles of broth containing from 3,000 to 3,500 cc. each, previously brought to 35 C. One tube of glucose brain broth culture containing approximately 15 cc. was used in inoculating each large bottle of broth made 0.2 dextrose from a 60 per cent autoclaved solution of dextrose in water. The large batches of broth were prepared usually from Armour's peptone and Liebig's extract of beef, the reaction brought to p_H 7.8 and autoclaved at 20 pounds for one and one-half hours. These large inoculated volumes of broth were incubated for from eighteen to twenty-four hours until a heavy growth occurred. The bacteria were then harvested with the Sharples continuous feed centrifuge, and suspended in 50 per cent glycerol or in the mixture of glycerol and sodium chloride solution. The growth from approximately 500 cc., or 1,000,000,000,000 bacteria, was suspended in each cubic centimeter, glass beads were added and the mixture was thoroughly shaken before it was placed in the icechest. Calculated amounts corresponding to the number of bacteria required for the injections were diluted as needed with from 20 to 30 cc. of sodium chloride solution on the day of injection.

If dead bacteria were required for immunization, 0.2 per cent cresol was added to the diluted suspensions several hours before injection. If immunization had proceeded far enough, the diluted suspensions containing a variable number of living bacteria, depending on the age of the dense suspension, were directly injected.

Injections were made slowly into the jugular vein on three successive days, then four days intervened without injections to permit the serum to attain a high content of agglutinin and precipitin, after which the injections were usually given only once a week. In this way the horses almost never developed acute symptoms resembling anaphylactic shock. The number of bacteria injected was small at first, then gradually increased, varying from approximately 25 to 2,000,000,000,000 organisms. The maximal dose, usually from 1,000,000,000,000 to 2,000,000,000,000, was so adjusted to the individual horse that the animal remained well and did not lose weight. The serum was not considered useful for treatment, irrespective to the content of agglutinin and precipitin, until horses had been immunized for at least six months. The horses usually yielded suitable serum for many months, and some remained well for as long as three years. The agglutinin and precipitin content was considered sufficient if almost immediate agglutination of organisms (young cultures 2 parts, and serum 1 part, mixed on a slide) occurred, and if a dense cloud formed within ten minutes at the point of contact between cleared extracts of sodium chloride solution and the serum in precipitin tubes. Trial bleedings were made at intervals, and if agglutinating and precipitating content had become high and remained so, bleedings of 10 liters were made in a sterile manner about once a month one week after the last injection. The blood was allowed to clot, tinned weights were applied, the jars placed in the refrigerator and the clear serum was decanted forty-eight hours later when 0.2 per cent cresol was added. The serums from individual bleedings were proved sterile by at least two sets of aerobic, anaerobic and partial tension cultures. The mixture of the different bleedings and samples of at least twelve of the final containers were in turn proved sterile. The final mixture, besides being sterile, had to be nontoxic when injected intravenously into guinea-pigs in amounts equivalent to about 600 cc. for adult persons. The serums used for treatment of the cases included in this report usually contained bleedings that either neutralized true virus in vitro, or tended to arrest or prevent paralysis or lowered the mortality rate in monkeys inoculated intracerebrally with virus, or in rabbits inoculated intravenously with the pleomorphic streptococcus. They all possessed marked agglutinating power over homologous as well as heterologous cultures, and marked precipitating power over sodium chloride solution extracts of strains that were dried in vacuo in 1916, as well as over

strains preserved in the mixture of glycerol and sodium chloride solution from cases occurring in epidemics since then.

The injections of the serum in the cases included in this report were made intravenously or intramuscularly. The inherent toxic effects of horse serum when given intraspinally precluded this method of administration. The indications as to the exact amount for a single injection and as to the number of injections were determined in individual cases by the age of the patient, the severity of the attack, the duration of symptoms, and the effects of a previous injection. The return of fever and high pulse rate twenty-four hours after an initial drop, which was common, and the return of symptoms referable to the central nervous axis (irritability, twitchings, pain in extremities, rigidity of neck, and so forth) after a primary disappearance or diminution, or the persistence of these symptoms, were considered indications for the need of more serum. In general, children up to the age of 2 years received at least 15 to 25 cc. of serum, those from 2 to 5 years, inclusive, from 20 to 30 cc., those from 6 to 12 years, from 25 to 50 cc., and persons 13 years of age and more, from 50 to 75 cc. We have learned that even if a child appears to have recovered fully twenty-four hours after an early injection of the serum, a second injection had better be given at that time, for in several instances recrudescence with paralysis developed when one injection had seemed to be sufficient. If no apparent benefit followed three or four daily injections in patients who had developed paralysis from several days to a week previously and the temperature had returned to normal, further use of the serum was considered of no value.

When the serum was given intravenously, it was previously warmed to body temperature and was injected at the rate of 1 cc. each minute, but when given intramuscularly or subcutaneously it was injected more rapidly. The interval between injections was usually twenty-four hours, but in urgent cases the injections were sometimes repeated every twelve hours. The usual precautions regarding hypersensitiveness to horse serum were taken before giving therapeutic injections, and parents were told of the serum reaction which was prone to occur later.

RESULTS

Mayo Clinic Cases.—We wish first to consider the effects of the serum in patients whom we ourselves saw, in whom, among other points, the relative merits of intravenous and intramuscular injections and the question of spinal drainage were considered.

The cases studied occurred chiefly during several epidemics, one in Rochester, Minn., and its environs during the summer of 1921, one in Buffalo and Trempeleau Counties, Wis., in 1925, and one in and about

Rochester in 1925. The number of cases in proportion to the total population, the type of the disease, its incidence, and its distribution were much as in epidemic poliomyelitis generally, except that the incidence of early involvement of the medulla was unusually high. Nearly all of the patients were seen at home in consultation with the family physician with as little delay as possible, and the first injection of serum was given as soon as the diagnosis was established, usually by spinal puncture and bedside examination of the spinal fluid. Children were not removed from their beds, and every effort was made to win their confidence in order to avoid, so far as possible, undue fright and muscular effort when the spinal puncture and serum injection were made.

Altogether, we have seen 109 cases (forty-five males and sixty-four females) in which the diagnosis was reasonably certain. Thirty-one patients were not paralyzed at the time of the first serum treatment, twenty-five had already developed slight, and fifty-three either moderate or marked paralysis. Of the thirty-one in the first group, one (3.3 per cent) died; of the twenty-five in the second group, one (4 per cent) died, and of the fifty-three in the third group, nine (17 per cent) died, a total of eleven patients (10 per cent) dying among the 109 who were treated. The average amount of time that had elapsed between the initial symptoms and the first serum injection in these three groups was, respectively, two and five-tenths, three and three-tenths, and four and two-tenths days; the average amount of serum given was 41, 35 and 64 cc., and the average age of the patients 9.4, 5.7 and 8.9 years. The average cell count of the spinal fluid for each cubic millimeter in twenty-four of the thirty-one in the first group was 175; in twenty-two of the twenty-five in the second group, 141, and in thirty-three of the fifty-three in the third group, 301. The average cell count in the fatal cases was 522, ranging from 180 to 1,056. The ages in the fatal cases ranged from 4 to 35 years, the average being 12.7 years.

In order not to cloud the issue, every patient who received serum, no matter how small the amount nor how late it was given (even as the patient was dying, in certain cases), was counted as a treated patient in considering mortality. The good effects of the serum in patients who received it early and in adequate dosage must be great enough, it was felt, to bring the total mortality rate and incidence of residual paralysis well below the average. In order, however, to have a truer expression of the value of the serum, we have corrected the mortality rates by eliminating the fatal cases in which the serum treatment was inadequate or too late. These included the cases of patients 1 year old or less that had not received at least 15 cc.; 1 to 5 years, 20 cc.; 6 to 10 years, 30 cc.; 11 to 15 years, 45 cc.; 16 years and older, 60 cc., and patients so badly paralyzed that they died within twelve hours after serum treatment.

Two of the eleven patients who died were moribund, death occurring within twelve hours after treatment. Two other received inadequate amounts of serum; one of these, a boy, aged 4, with paralysis so marked as to include the respiratory muscles, received one injection of 15 cc., and the other, a woman, aged 24, also severely paralyzed, received only 40 cc. The other seven patients were given the serum in time and in sufficient amounts to be effective. However, all had evidence of marked infiltration of the central nervous system, manifested by unusually high cell counts or marked weakness or paralysis before the serum was administered. The only patient in the group who died, with no paralysis at the time of the first injection, was a man, aged 35, with a cell count of 675 who had been taken a long distance to a hospital and whose daughter had died from a similar attack a week before. Three injections, the first after forty-eight hours of illness, 110 cc. in all, were without effect and death occurred eight hours after paralysis began and seventy-two hours after the onset of the symptoms. The only patient who died who had slight paralysis at the time of the first serum treatment, although his paralysis was primarily of the bulbar type, as he had had difficulty in swallowing for twenty-four hours before the first injection, had a cell count of 264 and should have responded to the three injections of serum, 20 cc. each, which were given. The strain isolated from the nasopharynx before death and from the brain and cord afterward was unusually virulent, producing a bulbar type of paralysis in rabbits, and resisted markedly the agglutinating effect of the serum injected. The remaining five patients all had marked paralysis when serum treatment was begun, on the third day in two, the fourth in two and the fifth in one, respectively. In two of these, temporary improvement followed the first injection of serum but subsequent injections were without effect. In the remaining three the serum was entirely without effect. One of these three patients had a rapidly ascending paralysis with early involvement of the respiratory center. The streptococcus isolated from the nasopharynx before, and from the brain and cord after death was unusually virulent and highly resistant to the agglutinating action of the serum injected. Thus, of the eleven patients who died, certainly four should not be counted against the serum. Excluding these from consideration, we have a total of 105 patients who received serum in time and in sufficient amounts for it to act, seven of whom died, giving a corrected mortality rate of 6.6 per cent.

Through the cooperation of McDaniel of the Minnesota State Board of Health, we have a basis for comparing the treated with the untreated patients reported in Minnesota in 1921 and 1925. In 1921, 702 cases with 102 deaths were reported, a mortality of 14.5 per cent. Subtracting the fifty-two patients treated with our serum and the six deaths leaves 650 cases with ninety-six deaths in which serum was not given, or a

mortality of 14.1 per cent. In 1925, 941 cases with 145 deaths were reported to the State Board of Health. Of these, 123 patients are known to have received serum, either from us or from physicians to whom the serum was sent, of whom thirteen (10 per cent) died, which leaves 818 untreated patients with 132 deaths, or a mortality of 16.1 per cent.

In analyzing the cases as regards the presence and the degree of residual paralysis we find here, as in the mortality rate, a much lower incidence, depending on how early the serum was injected. All of the thirty patients who lived and who received the serum before paralysis began recovered without developing paralysis. Of the twenty-four patients who lived and who had slight paralysis at the time of the first serum treatment, residual paralysis is absent in twenty-one, slight in two, and moderate in one. Of the forty-four patients who lived and who received serum first after paralysis was advanced, residual paralysis is absent in twenty-four, slight in eight, moderate in ten, and marked in only two.

The apparently good effect of the serum as noted at the bedside was often striking, and any one or more of the following changes, especially if noted within twenty-four hours after the injection of the serum, was considered a favorable result: Disappearance or diminution of the subjective symptoms such as pain, restlessness, hyperesthesia or mental apathy; disappearance of twitchings or spasms of muscles; disappearance of nausea and vomiting, or of diarrhea; return to normal or more nearly normal of reflexes that had been absent, diminished or increased; lowering of the pulse rate; drop in temperature; lessened rigidity of the neck or spine; no extension of a progressive paralysis, and improved muscle function. Often, restless, hyperesthetic, irritable, peevish children went to sleep soon after the serum was injected, and the mental condition even of semicomatose children became normal within twenty-four hours. Abolished reflexes returned, weakened muscles showed increased power, and progressive paralysis was often arrested. The temperature and pulse rate were often lowered, especially in the first two groups of cases. Good effects were nearly always more marked after the first injection. This was not due wholly to spinal drainage because it occurred alike in patients in whom a large amount of spinal fluid was removed and in those in whom only enough was removed for diagnosis, as well as in those in whom spinal puncture was not done.

Of the 109 cases there was a noticeable change for the better within twenty-four hours, or even within a few hours after treatment in ninety-four and no apparent effect in fifteen. In nine cases, the serum was administered seven days after the onset of symptoms; five of the patients appeared to be benefited while four did not. In general, the sooner the

serum was given after the attack the more striking were the results. In none did the serum seem to exert a harmful effect.

It has repeatedly happened that the first patient in the family or other contact groups developed paralysis before the disease was recognized, but that a second member, in whom an early diagnosis was made and serum treatment instituted, recovered without developing paralysis. Recovery without paralysis, if the serum was given early, occurred when the early symptoms were as severe and of the same general character as in the untreated patient or the case in which the serum was given late that ran a rapidly fatal course. We have sometimes observed, as have others, that paralysis which had already begun was arrested during the period of two or more daily injections of serum, only to extend on the second or third day after discontinuing serum treatment. In a few cases, such delayed progressive paralysis seemed to be again arrested by further administration of the serum. The value of serum treatment, and especially its harmlessness, seemed particularly well illustrated in the cases of two pregnant women with severe attacks of poliomyelitis, one being of the bulbar type, in which the serum was given soon after onset of widespread paralysis. Both recovered without developing permanent paralysis and without miscarriage at the time of the attack, or during the serum reaction a week or ten days later, and both gave birth to normal babies. Moreover, if the serum is given early in patients with respiratory involvement before cyanosis develops, it may arrest paralysis and avert a fatal issue.

ILLUSTRATIVE CASES

CASES 1 and 2.—A brother and sister, aged 11 and 16 years, respectively, patients of Dr. R. S. Mitchell of Grand Meadow, Minn., developed sore throat Sept. 8, 1925, which lasted for several days. On September 11, the boy developed fever and pain in the back of the neck, felt weak and exhausted, and was obliged to lie down. He was no better September 12, spending most of his time lying around. On September 13, he could scarcely sit up and had twitchings of the muscles in the right shoulder and hand and slight difficulty in swallowing. On September 14, he complained of pain in the neck and back. The head was retracted and attempts at flexion caused pain in the neck and back. The pupils were equal but dilated. The temperature was 101.5 F., the pulse rate 110. The patellar tendon reflexes were absent. He could scarcely lift the right leg from the bed, the grasping power of the right hand was markedly diminished, and the power of extension and flexion of the forearm and of lifting the arm from the shoulder was greatly diminished. He could scarcely swallow water, and weakness of the intercostal muscles on the right side was evident when he breathed deeply. A spinal puncture revealed clear spinal fluid under increased pressure, a cell count of 240, and the globulin test was positive. The sister developed similar early symptoms September 12, one day later than her brother. On September 13, she went to bed on account of general weakness, fever, and severe pain in her neck and back. On September 14, she felt weak and complained of pain in her back, shoulders, neck and eyes. The temperature was 102.5, the pulse rate 118. Examination revealed marked rigidity of the neck, a tremulous voice, occasional twitchings of the muscles of the hands and face, hyperemic congestion of the face and conjunctivae, and hyperactive knee jerks but no weakness anywhere. Expansion of the chest

was normal. A spinal puncture yielded clear spinal fluid under increased pressure, with a cell count of 172, and the globulin test was positive. Twenty-five cubic centimeters of serum was injected intramuscularly into each patient. The following day the paralysis in the boy had not extended. The difficulty in swallowing had disappeared, expansion of the chest was normal, and the neck was less rigid and less painful. The girl felt better, the neck was less rigid, the pain in the back had disappeared and paralysis had not developed. The temperatures were normal, the pulse rates lower. The serum injection was repeated on three successive days in the boy and on two in the girl. The girl recovered without developing paralysis, while the boy has moderate residual paralysis affecting the right shoulder.

Case 3.—A girl, aged 3, a patient of Dr. C. D. McKaig of Pine Island, Minn., was perfectly well until the evening of Sept. 20, 1921, six days after her cousin and playmate, a boy, aged 4, died suddenly from a mysterious cause. Necropsy five days after burial disclosed typical microscopic lesions of poliomyelitis in the brain and medulla. The little girl was feverish in the evening, slept poorly and had high fever that night. The mother noticed marked twitchings of the muscles during the restless sleep. The following morning the child complained of pain in the back of her neck, refused breakfast, and wanted to lie on the couch. At 10:30 a. m. she had a temperature of 104 F., a pulse rate of 168, rigidity of the neck, and a positive Kernig sign, but her knee jerks were normal. At 2 p. m. the cheeks were flushed, the eyes dull. The knee jerks were weak, especially on the left side, the Kernig sign was easily elicited, the neck was rigid and attempts to bring the head forward caused pain in the neck and back. There were occasional sharp twitchings of the muscles of the fingers and face. The throat was diffusely red and covered with mucus. A spinal puncture revealed clear fluid, only 3 cc. of which was withdrawn. The cell count was 196, and the globulin test was positive. Twenty cubic centimeters of the serum was injected intramuscularly. Thirty minutes later the child fell asleep, slept quietly for several hours without twitchings, slept well during the night and was hungry the following morning. Twenty-four hours later the temperature had dropped to 99 F., the pulse rate to 108, and the serum injection was repeated. Paralysis did not develop and recovery was complete.

Case 4.—A girl, aged 15, a patient of Dr. J. P. Reinhardt of Fountain City, Wis., was well until July 14, 1925, when for unknown reasons she felt indisposed. The following day, severe pain developed in the lower part of the back and abdomen, which was thought to be due to her first menstrual period. On July 16, the temperature was 100 F., the pulse rapid, and she complained of pain in the left arm and leg, and back of the neck. Ten cubic centimeters of serum was injected intramuscularly. On July 17, the temperature was 101, the pulse rate 120. She had pain in the neck and back, especially when the head was flexed. The pain in the left arm and leg had disappeared, but weakness of the left deltoid and extensors of the left leg had developed. The knee jerks were exaggerated, especially on the right side. Marked weakness of the intercostal muscles was noted and respiration was mostly diaphragmatic. The voice was weak, expulsive power in coughing was markedly diminished, the respirations were shallow but there was no cyanosis. Spinal puncture revealed clear fluid under moderate pressure; only 15 cc. was removed because the patient complained of severe headache as the fluid slowly escaped. One hundred and thirty-two cells were found in each cubic millimeter, and a positive globulin test was obtained. Fifty cubic centimeters of the serum was injected intravenously. The following day the temperature was normal, the pulse rate about 100, the knee jerks were absent, and both deltoids were weak. Respirations were still chiefly diaphragmatic. Forty cubic centimeters of serum was injected intramuscularly. There was no extension of paralysis by the next day, and expansion of the chest had improved; 40 cc. of serum was given in the morning and 20 cc. in the evening, then no more serum was considered necessary. Paralysis did not extend until three days later when marked weakness of both legs, abdominal muscles and the

back developed. Through orthopedic aid, recovery, although slow at first, has been unusually marked. The patient is able to walk with the assistance of braces, and indications are that there will be almost complete restoration of muscle function except in the left deltoid, the muscle first involved.

CASE 5.—A woman, aged 37, a patient of Dr. J. J. Powell of Galesville, Wis., had been well until the evening of July 19, 1925, when she felt exhausted owing, she thought, to a six months' pregnancy and the care of a child with an abortive attack of poliomyelitis. She was no better the next two days, became dizzy on stooping, and during the night of July 21 had a temperature of 101 F. At 6:00 a. m., July 22, her temperature was 101, pulse rate 90. She felt generally weak but the reflexes were normal and there was no rigidity of the neck. At 4 p. m. the temperature was 100, the pulse rate 160. She complained of shortness of breath and difficulty in swallowing, and shortly before had vomited violently. Fifty-six cubic centimeters of the serum was injected intramuscularly. At midnight she was extremely short of breath, was unable to swallow, expansion of the chest was limited, and the left side of the face and left eyelid were paralyzed. For cubic centimeters of serum was injected intravenously. On July 23 at 10:30 a. m., her general condition and heart action had improved. There was less dyspnea and she could swallow water. Thirty cubic centimeters of serum was now given intravenously and 50 cc. intramuscularly. At 3 p. m. marked improvement had occurred; respirations were normal, the pulse was regular, and the rate 120; she could lie in a recumbent position, the chest expanded almost normally and equally on deep inspiration, the difficulty in swallowing had disappeared, and the left side of her face was less drawn than during the night. There was no noticeable weakness of the arms, legs or muscles of the neck. The left knee jerk was diminished, the right exaggerated. The neck was moderately rigid and retracted, the spinal fluid, under slightly increased pressure, was clear and contained 102 cells in each cubic millimeter. Sixty cubic centimeters of serum was given intramuscularly that night. The patient made a complete recovery without residual paralysis, and three months later gave birth to a normal infant.

CASE 6.—A girl, aged 10, a patient seen with Drs. H. J. Heusinkveld and H. R. Sugg, Clinton, Iowa, was well until August 30, at 2:00 p. m., when she ran into the house from play saying, "Oh. mother! my head feels like it is going to split; it feels like a thousand pins and needles!" She was put to bed immediately. In fifteen minutes she was unconscious and the right arm and leg had become helpless. At 2:45 p. m. the child was comatose and could not be roused. There was lateral nystagmus, the pupils were equal but dilated, the color was good, breathing was regular, the rectal temperature was 98 F., the pulse rate 72, and knee jerks, Kernig's sign and rigidity of the neck were absent. The Babinski sign was bilateral. The left arm and leg responded freely to a pin prick, but the right arm and leg gave no response. Spinal puncture yielded fluid under increased pressure, and it was bright with blood. At 5.30 p. m., 22 cc. of poliomyelitis antistreptococcus serum was injected intravenously. On August 31, at 2:00 a. m., motion in the right arm and leg began to return, and by 6 a. m. the child had become conscious. At 8:30 a. m. the pulse rate was 70, the rectal temperature 99.2. There was slight rigidity of the neck, the Babinski sign had disappeared and the Kernig sign had developed. That evening the child was bright and felt quite well. She could move her right arm and leg freely. At 8.30 a. m., September 1, the child was bright and not paralyzed, the temperature was 100.4, and the pulse rate 80, but it was thought best to make another spinal puncture. The fluid again contained much blood and the pressure was greatly increased. When 5 cc. had been removed the child complained of frontal headache. The stylet was replaced for several minutes. When an additional 5 cc. had escaped the child again complained of headache and the needle was withdrawn. Two hours later the child became listless and stuporous and remained in this condition until evening, when 25 cc. of serum was injected intravenously. The stupor again disappeared. The following day, September 2, she was bright and without signs of paralysis. At night, twenty-four hours after the last injection, stupor and

rigidity of the neck again returned. The temperature was 100.4, the pulse rate 80. Twenty cubic centimeters of serum was given intramuscularly and again the stupor disappeared. The following day the child was bright and the neck less rigid. There was no paralysis and the knee jerks were normal. Twenty-eight cubic centimeters of serum was injected intramuscularly. Recovery was then complete and uneventful.

OTHER CASES

We wish now to consider the results obtained by physicians to whom serum was sent on request for study and who reported their observations on questionnaires, and to summarize the results of all patients treated during the years 1921 to 1925. The study includes a consideration of 1,113 patients treated with serum, and 278 controls, in whom the epidemiologic, clinical or spinal fluid observations leave no reasonable doubt as to the correctness of the diagnosis of poliomyelitis. The series includes cases that occurred under widely different conditions, in rural and in small and large urban communities of widely separated regions of the United States and Canada over a period of five years. Sharp epidemics comprising many cases, and smaller outbreaks of varying intensity, mortality rate and type, as well as a large number of sporadic cases, are represented. The control cases occurred mainly in the same localities as the serum treated cases, but for one reason or another, the serum was not administered. The sex incidence was nearly equal in both groups, although the males were somewhat more numerous in the treated group and the females in the control group.

Most of the injections were made intramuscularly, about 10 per cent intravenously chiefly in desperate cases, but in none was the serum injected intraspinally. On analysis the average amount of serum given the patients in the various age groups was found to be about the same in those that recovered and those that died. The average amount given to children up to 5 years of age, inclusive, was 37 cc.; those from 6 to 10 years, 45 cc.; those from 11 to 15 years, 54 cc., and patients 16 years or older, 68 cc. The average amount given each patient was 48 cc. The number of injections varied from 1 to 5.

Table 1 [10] gives a summary of the results as indicated by mortality according to age in the different groups with, respectively, no, slight, moderate or marked paralysis at the time of the first serum treatment, and in the control group. The age incidence in both the treated and control group was about the same as usual in cases of poliomyelitis, the age of 69 per cent of the treated patients and 70 per cent of the controls being 10 years or less. It will be seen that, with few exceptions, the good effect from the use of the serum in each of the age groups was inversely proportional to the degree of involvement at the time of the first serum treatment, and that the mortality rate was consistently much lower in the treated than in the control group and in the New York

TABLE 1.—*Mortality According to Age*

Patients Treated with Serum; Condition at Time of First Serum Treatment	0 to 5 Years			6 to 10 Years			11 to 15 Years			16 Years and Older			All Ages		
		Deaths			Deaths			Deaths			Deaths			Deaths	
	Cases	Number	Per Cent	Cases	Number	Per Cent	Cases	Number	Per Cent	Cases	Number	Per Cent	Cases	Number	Per Cent
No paralysis	97	4	4.1	97	0	0.0	52	1	1.9	23	3	13.0	269 (267)	8 (6)	2.9 (2.2)
Slight paralysis	77	6	7.7	45	0	0.0	20	4	20.0	20	5	25.0	162 (157)	15 (10)	9.2 (6.3)
Moderate paralysis	88	4	4.5	44	3	6.8	15	2	13.3	35	8	22.8	182 (176)	17 (11)	9.4 (6.2)
Marked paralysis	178	22	12.3	140	36	25.7	74	26	35.1	108	36	33.3	500 (444)	120 (64)	24.0 (14.4)
Total	440	36	8.2	326	39	11.9	161	33	20.5	186	52	27.9	1,113 (1,044)	160 (91)	14.3 (8.7)
Control group, not treated with serum	149	29	19.4	58	18	31.0	35	16	45.7	36	19	52.7	278	82	29.5
Patients not treated with serum. Reported in literature (Nicoll, M.: New York State J. Med. **17**: 270, 1917), New York state 1916..	8,317	2,362	28.4	2,319	601	25.9	531	138	26.0	515	212	41.1	11,682	3,313	29.2
Patients not treated with serum. Reported in literature. Miscellaneous epidemics in United States, 1917-1925: Bolt (footnote 1); Diveley, R. L. J. A. M. A. **84**: 85, 1925); Field, C. G. (Iowa State M. J. **13**: 48, 1923); Peabody (footnote 3); Taylor, E. (New York State J. M. **17**: 279, 1917); Taylor, R. T. (Am. J. Orthop. Surg. **15**: 759, 1917); Weisenburg, T. H., and Leopold, S. S. (Pennsylvania M. J. **21**: 86, 1917)												1,191	293	24.6

epidemic of 1916. The average mortality for all ages in the group that had no paralysis at the time of the first serum injection was 2.9 per cent; in the group with slight paralysis, 9.2 per cent; in the group with moderate paralysis, 9.4 per cent; in the group with marked paralysis, 24 per cent, an average of 14.3 per cent for all groups, which is in sharp contrast to the average mortality rate of 29.5 per cent in the control untreated group, 29.5 per cent in the New York cases, and 24.6 per cent in cases reported in other parts of the United States from 1917 to 1925. This lower mortality in the treated group occurred, despite the fact that the incidence of the bulbar type of the disease was higher in it. In 1,113 treated patients, 128 (11.6 per cent) cases were of the bulbar type, in contrast to nineteen (6.8 per cent) of the 248 control cases. In the 128 treated patients with bulbar cases sixty-seven (52.3 per cent) died, whereas in the nineteen control cases, fifteen (78.8 per cent) died. The results as given for the treated patients include all cases in which serum was administered, no matter how small the amount or whether given as the patient was dying, and hence are not a true expression of the value of the serum. In table 1, the figures in parenthesis under "all ages" represent the cases, deaths and mortality in the four groups with, respectively, no, slight, moderate, and marked paralysis at the time of the first serum treatment, after subtracting the number of cases that proved fatal after inadequate amounts of serum or serum given too late to have effect. It will be seen that the corrected mortality rate in the four groups was decidedly lower. Thus in the group without paralysis there were 267 cases with six deaths, or a mortality rate of 2.2 per cent. All of the six fatal cases, while free from paralysis, were severe from the beginning, with marked infiltration of the nervous system as manifested by high cell counts, and all but one of the patients were ill for from forty-eight to seventy-two hours before the first injection of serum was given. In the group that already had slight paralysis, there were 157 cases with ten deaths, or a mortality rate of 6.3 per cent. In the group with moderate paralysis there were 176 cases with eleven deaths, a death rate of 6.2 per cent; in the group with marked paralysis there were 444 cases with sixty-four deaths, a mortality rate of 14.4 per cent. In the 1,044 cases considered as adequately treated, ninety-one patients died, making the average corrected mortality rate only 8.7 per cent.

After mortality, the next most important considerations in the treatment of poliomyelitis are the incidence and degree of residual paralysis. Table 2 summarizes the results in 866 treated patients and 177 control cases from this standpoint. It will be seen that the incidence and degree of residual paralysis are in direct proportion to the condition of the patient at the time when the serum was first given, and that the total average incapacity is far lower in the patients who received serum than in those

who did not. Marked residual paralysis in the four groups was, respectively, 2.6, 2.4, 6, and 31.4 per cent, an average of 15 per cent which is in sharp contrast to 28 per cent in the control group.

In the group that had marked paralysis at the time of the first serum treatment, there were forty patients to whom either inadequate amounts of serum were given or to whom it was given seven days or more after the onset of symptoms. Disregarding these, there were 317 patients, seventy-two (22.7 per cent) of whom had marked residual paralysis.

Among the other three groups there were four patients with marked residual paralysis who received inadequate amounts of serum. Subtracting forty-four from the total number of patients and from those having

TABLE 2.—*The Incidence and Degree of Residual Paralysis in Patients Treated with Serum and in Control Cases*

Groups Treated with Serum: Condition at Time of First Serum Treatment	Total Cases Reported	Residual Paralysis, Degree							
		None		Slight		Moderate		Marked	
		Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent
No paralysis.....	232	188	81.0	31	13.4	7	3.0	6	2.6
Slight paralysis.....	127	70	55.1	46	36.2	8	6.3	3	2.4
Moderate paralysis.	150	39	26.0	48	32.0	54	36.0	9	6.0
Marked paralysis...	357 (317)	96	26.8	75	21.0	74	20.7	112 (72)	31.4 (22.7)
Total.....	866 (822)	393	45.3	200	23.0	143	16.5	130 (86)	15.0 (10.4)
Control group (not not treated with serum).....	177	56	31.0	35	19.0	36	20.3	50	28.0

marked residual paralysis we have a total of 822 patients properly treated, of whom eighty-six (only 10.4 per cent) have marked residual paralysis (figures in parenthesis in table 2).

In considering the patients from the standpoint of the duration of acute symptoms at the time of the first serum treatment, we find that the proportion receiving serum on the second day or earlier was highest in the group having no paralysis (65 per cent), lower in the group that had slight paralysis (35 per cent), still lower in the group that had moderate paralysis (29 per cent), and lowest in the group that had marked paralysis (22 per cent), the average length of time of the first serum injection in the four groups being two, three and five-tenths, four and nine-tenths, and five and four-tenths days, respectively, after the onset of acute symptoms. The total average duration of symptoms before serum treatment was four and two-tenths days.

From the general nature of the study, there was reason to believe that the patients receiving serum at the hands of the physicians to whom the serum was sent for study had, on the average, more severe attacks, suggesting the need for serum, than the control group. This was found,

on analysis, actually to be the case. Of 931 patients treated with serum, 88 per cent had moderate or severe initial symptoms, whereas 75 per cent of the 244 control patients had similar initial symptoms, and of the patients treated with serum only 12 per cent had slight initial symptoms, in contrast to 25 per cent of the control group. Moreover, there was a higher incidence of primarily bulbar types of the disease in the treated than in the control group, 11.6 against 6.8 per cent.

An estimate of the clinical effects of the serum was reported by the attending physician in 647 cases altogether. Early good effects were reported in a total of 488 (74 per cent) and doubtful effects in 159 (26 per cent). No harmful effects were reported in any case. In studying the incidence and degree of serum reaction we find that of 749 cases there was no immediate reaction in 602 (80 per cent), and that there was a marked reaction immediately after giving the serum in sixty-one (8 per cent). The occurrence or not of a late serum reaction was reported in 864 cases. Of these, 373 (43 per cent) had none and 194 (22.4 per cent) had marked late reactions. In no case did the reaction appear to augment the symptoms. The incidence of apparently early beneficial results was greatest in the group that received serum before the onset of paralysis, 181 (94 per cent) of 192 cases, somewhat less in the group that had slight or moderate paralysis, 160 (72 per cent) of 222 cases, and lowest in the group that had marked paralysis at the time of the first serum treatment, 147 (63 per cent) of 233 cases. Moreover, apparent benefit was derived by seventy-six (56 per cent) of 136 patients with marked paralysis at the time of the serum treatment, and in whom the serum was given seven days or more after the onset of symptoms.

It is, of course, realized that to estimate the benefits of any form of treatment in this disease is most difficult. Slight improvement may be of no significance, but a marked change for the better soon after the serum is administered is believed to be significant. The statements of the attending physician regarding the benefits were often extravagant, but leave little doubt that the results were attributable to the effects of the serum, because they were in close harmony with our own observations.

It is generally believed that a high cell count in poliomyelitis is indicative of severity. Although notable exceptions occurred, this was the case in both the treated and control groups. Thus, of 291 treated patients with a cell count of 100 or below, thirty-two (11 per cent) died, and of sixty-three control untreated patients, eleven (21 per cent) died, whereas of 178 treated patients with a cell count of 100 to 500, thirty-five (19.6 per cent) died, and of twenty-seven controls, twelve (44.4 per cent) died. Of eleven patients who had a cell count of 500 or more and who received the serum before marked paralysis had set in, only two

(18 per cent) died. Five (50 per cent) of ten patients with a cell count of 500 or more who had developed marked paralysis before treatment died, whereas all of three untreated controls with equally high cell counts died.

In table 3 is given the average cell count of the treated patients that recovered, of those who died and of both these groups, according to the degree of involvement at the time of the first serum treatment, and of the control group, without respect to the initial condition. With one exception, the average cell count in these four groups was decidedly higher among the patients who died than among those who recovered; the average cell count among the patients with no paralysis at the time of the first serum treatment was higher than in the other groups, and the total average cell count among the treated patients was higher than in the control group.

TABLE 3.—*Average Cell Count in Spinal Fluid*

Treated Patients: Condition at Time of First Serum Treatment	Recovery		Death		Total	
	Cases	Cell Count	Cases	Cell Count	Cases	Cell Count
No paralysis	148	160	7	184	155	168
Slight paralysis	60	119	8	101	68	117
Moderate paralysis	50	87	11	102	61	90
Marked paralysis	144	119	41	193	185	135
Total	402	133	67	166	469	138
Controls	67	62	23	167	90	90

THE FACTOR OF SPINAL DRAINAGE

Temporary relief from symptoms following withdrawal of spinal fluid in cases of poliomyelitis has been noted by different observers,[11] and many believe that it tends to avert the catastrophe of paralysis in some cases. On the other hand, too rapid withdrawal of spinal fluid and in too large an amount may be harmful. In several cases respiratory paralysis was seemingly initiated by this circumstance. In previous publications, one of us pointed out that the good effects which follow the administration of the serum are not due to the spinal puncture which is made as a routine just previously, because the amount of spinal fluid withdrawn is often too small to have therapeutic effect and that similar improvement occurs without spinal puncture. Moreover, it was also determined that pressure rarely becomes abnormally increased following the administration of the first dose of serum, and that subsequent spinal punctures are without value in patients receiving serum. In order to confirm, if possible, the curative value of the serum and to eliminate the factor of spinal drainage as the cause of the early benefit noted so commonly following administration of the serum, only enough spinal

11. Montgomery, J. C., and Cole, W. C. C.: Spinal Drainage: Value in the Treatment of Early Poliomyelitis, J. A. M. A. **85**:890 (Sept. 19) 1925.

fluid (from 1 to 5 cc.) for diagnostic purposes was withdrawn immediately before giving the serum in a series of ten cases during the epidemic in Rochester in 1921, and in most of the remainder by withdrawing only from 10 to 15 cc. The results in these cases were as strikingly favorable as in those in which a larger amount of spinal fluid was withdrawn. Moreover, similar good effects were noted in a few undoubted cases of poliomyelitis in which either spinal puncture was unsuccessful or consent for it was not obtained.

ILLUSTRATIVE CASES

CASE 7.—A boy, aged 10, was seen in consultation with Dr. G. T. Joyce of Rochester, Minn., Sept. 17, 1921. The patient had become ill two days before, complaining of fatigue, pain in the back of the head, and anorexia. He had fever, twitchings of the muscles of the face and arms, and was very nervous. Examination revealed rigidity of the neck with moderate retraction of the head, exaggerated reflexes, and occasional sharp spasms of the muscles of the face and arms. On spinal puncture only 2 cc. of clear spinal fluid was removed. The cell count was 319; lymphocytes predominated. The globulin test was strongly positive. The temperature was 101 F., the pulse rate 120. Two injections of serum of 20 cc. each were given twenty-four hours apart. The patient was better the day following the first injection, the pulse was less rapid, the temperature dropped to normal, the twitchings of the muscles disappeared, the reflexes were more nearly normal and the rigidity of the neck was less marked. He recovered without developing paralysis.

CASE 8.—A boy, aged 3, was seen Sept. 16, 1921. The child complained of pain in the back of the head and neck for two days before. He was inactive, drowsy and feverish, refused to eat, and during sleep there were marked twitchings of the muscles, chiefly of the upper extremities and face. On examination, the voice was found to be tremulous, there were marked tremor of the hands and twitchings of the muscles of the fingers, the eyes were dull, and the head was held in a retracted position. When the child was made to walk, marked tremor of the lower extremities and apparent weakness of the right leg were noted. In attempting to flex the head, he complained of severe pain in his neck and back. Reflexes of the upper extremities and knee jerks were markedly exaggerated, especially the knee jerk on the right side. The pulse rate was 140 and the temperature 102 F. The throat was moderately injected and there was grayish adherent mucus in the nasopharynx. A spinal puncture was made and only 2 cc. of clear spinal fluid was removed. The cell count was 197, the globulin test was positive, and 20 cc. of serum was injected intramuscularly. There was no reaction following the injection. The patient fell asleep several hours afterward, and slept most of the afternoon without twitchings of the muscles. He slept well during the night and was hungry the next morning. His temperature had dropped to normal, the pulse rate had dropped from 140 to 90, the reflexes were normal, there was no weakness anywhere, and the twitchings of the muscles had entirely disappeared. The serum injection was repeated and the child made an uneventful recovery without developing paralysis.

CASE 9.—A girl, aged 10, was seen, Aug. 29, 1921. Three days before, she had developed intense headache, nausea, stiffness of the neck and retraction of the head, diarrhea, and pain in the back. Marked weakness of the muscles of the back became manifest the day before we saw her, and she was unable to sit or stand. By the next day the muscles of the back had grown weaker, the grasping power of the left hand was greatly diminished, there was weakness of the muscles of the left side of the face, slight weakness of the left leg and bulging of the muscles of the right side of the abdomen when the patient attempted to raise her

head. The tonsils were enlarged, the soft palate and throat were red, a small amount of tenacious adherent mucus was found in the pharynx, and the tongue was coated. A spinal puncture was unsuccessful. Three intramuscular injections of 20 cc. of serum, twenty-four hours apart, were given. The paralysis did not extend after the injection of the serum, the headache disappeared, the general condition improved and the patient made a slow but complete recovery. These results are in accord with those reported to us by physicians to whom serum was sent.

COMMENT

Thus, of a total of 304 cases without spinal puncture in which a bedside estimate as to the value of the serum was reported, early good effects were noted in 237 (78 per cent) and doubtful effects in sixty-seven cases, and of 343 cases in which spinal puncture was made, early good effects were noted in 251 (70 per cent) and no apparent effects in ninety-two cases. Moreover, these observations are in accord with the mortality rates in a group with and a group without spinal puncture;

TABLE 4.—*Mortality According to Year of Epidemic*

	Patients Treated with Serum			Controls		
		Death			Death	
Year	Total Cases	Cases	Per Cent	Total Cases	Cases	Per Cent
1921	81	18	22.0	53	24	45.3
1922	125	19	15.2	84	24	28.5
1923	73	14	19.0	7	2	28.5
1924	390	46	11.8	24	6	25.0
1925	444	63	14.2	110	26	23.6
Total	1,113	160	14.4	278	82	29.5

they were approximately the same in the two groups. Thus, of the 1,113 patients treated with serum, spinal puncture was done in 546, of whom eighty-three (15 per cent) died. Of the remaining 567 in whom spinal puncture was not done, seventy-seven (13.2 per cent) died. Of the 278 controls spinal puncture was done in 107, twenty-eight of whom (26 per cent) died, and of the remaining 171 patients, fifty-four (31.8 per cent) died.

It was considered worth while to study the treated and control groups according to the year of the epidemic (table 4). The mortality rate of the treated group in each year was consistently about half as great as in the control group. The excessively high mortality rate during 1921 was due to an unusually high incidence of bulbar types of the disease.

The serum has now been used over a period of eight years, and its effects have been reported in a series of epidemics (table 5).[10] Here again it will be noted that the mortality rate among the treated groups is consistently lower than among the respective control groups. It is generally believed that mortality from poliomyelitis is higher during the early part of an epidemic than during the latter part. The excessively high mortality rate among the untreated controls at Dubuque, Iowa, in

1918 and at Missoula, Mont., in 1921, may be due in part to this factor, for five of the eight deaths among the control group at Dubuque, and four of the eight at Missoula, occurred before serum treatment was instituted. In the other epidemics, serum treatment was begun at once, or very soon after the disease made its appearance. The untreated patients had conditions of the same severity, and they occurred at about the same time and under similar conditions, usually in the same locality and always in the same state, but for one reason or another the serum had not been administered to them. The excessively high mortality rate

TABLE 5.—*Results According to Epidemics of Serum Treatment Contrasted with Other Treatment*

		Serum Treatment			Other Treatment		
			Death			Death	
Epidemics	Observer	Total Cases	Cases	Per Cent	Total Cases	Cases	Per Cent
Davenport, Iowa, 1917...	E. C. Rosenow (J. Infect. Dis. **22**: 379 1918)	58	10	17.2	23	9	39.0
Dubuque, Iowa, 1918.....	J. J. Rowan, Jr. (M. Rec. **96**: 972, 1919)...	68	3	4.4	17	8	47.0
Rochester, Minn., 1921...	E. C. Rosenow.....	52	6	11.5	650 (Minn.)	96	14.7
Clinton, Iowa, 1924.....	H. R. Sugg (J. Iowa State M. Soc. **15**: 573, 1925)	37	..	....	28 (Iowa)	12	42.8
Rochester, Minn., and Galesville, Wis., 1925	E. C. Rosenow and A. C. Nickel	57	5	8.7	818 (Minn.)	132	16.1
Missoula, Mont., 1921....	F. D. Pease.....	51	2	3.9	27	8	29.6
Billings, Mont., 1922.....	J. J. Sippy.....	35	2	5.7	7	2	28.6
Washington state, 1921..	.....	66	16	24.0	53	24	45.0
Omaha.....	Floyd Clarke (J. A. M. A. **83**: 421, 1924).....	6	..	....	50	9	18.0
Detroit.....	R. W. Pryer and B. Bernbaum	28	4	14.2	52	10	19.2

both in the treated and control groups that occurred in the state of Washington in 1921 was due to an excessively high incidence of bulbar types of the disease.

Especially noteworthy are the results obtained by Sugg in the epidemic at Clinton, Iowa, in 1924. The diagnosis was made, usually by spinal puncture, and serum treatment was instituted relatively early. Injections in adequate amounts were made intravenously in almost every instance. The thirty-seven cases treated were of the usual severity and type. No deaths occurred among these patients. In several, the serum seemed to be life saving. The incidence of residual paralysis was about similar to that obtained in our series.

In the patients of Pryer and Bernbaum, the disease was thoroughly controlled in the hospital. The serum treatment was begun unusually late, but even so the mortality rate in the treated patients (14.2 per cent)

was lower than in the controls (19.2 per cent). They also used convalescent serum for nineteen patients, of whom six (31 per cent) died. Well marked improvement occurred three weeks later in 68 per cent of the patients who had received the poliomyelitis antistreptococcus serum; in 31 per cent who had received convalescent serum, and in 58 per cent who had received no serum.

SUMMARY AND CONCLUSIONS

Altogether, the results in 1,113 patients with poliomyelitis who received serum and in 278 control untreated patients are elucidating. The mortality rate was found to be much lower in the treated than in the control group, especially when the serum treatment was begun early, even if there were bulbar symptoms. This was true in each of the four age groups (up to 5 years, from 6 to 10, 11 to 15, 16 years and more), in each of the five years from 1921 to 1925, as well as in each epidemic studied.

The incidence of residual paralysis was also much lower in the treated than in the control group, especially in those patients who received serum before or soon after slight paralysis had developed. The mortality rate and the incidence of residual paralysis in the control group were not abnormally high, and corresponded closely to those untreated patients whose cases are reported in the literature.

The incidence of the more severe initial symptoms, the average cell count, and the incidence of initial bulbar types of the disease were somewhat higher in the treated than in the control group. The age incidence was about the same in the two groups. The good effects of the serum occurred independently of spinal drainage. The results in the patients treated by others are in agreement with our results in this and in previous studies, as regards mortality rate, incidence of residual paralysis, and bedside impressions concerning early good effects of the serum. The number and variety of the patients treated are sufficient, and control observations are adequate, to justify the conclusion that the poliomyelitis antistreptococcus serum is of value in the treatment of acute anterior poliomyelitis.

The serum used possessed the power of neutralizing the toxic material contained in cultures of the streptococcus, as measured by intracutaneous injection;[12] it diminished the infective power in vitro of the streptococcus as measured by intracerebral injection, and it cured rabbits inoculated intravenously with the streptococcus, properties not possessed by normal horse serum. Some of the batches of serum neutralized the virus in vitro, and protected monkeys against poliomyelitis in the forced

12. Rosenow, E. C.: A Skin Reaction in Poliomyelitis, J. Infect. Dis. **38**:529, 1926.

experiment by intracerebral inoculation of virus. Rabbits have been immunized against intracerebral inoculation of the streptococcus by the methods used in the preparation of the serum in horses; hence the curative action noted clinically would seem attributable to the specific antibodies contained in the serum, and not to nonspecific or foreign protein effects.

EFFECT OF ULTRAVIOLET LIGHT ON THE BLOOD OF NEW-BORN INFANTS

PRELIMINARY REPORT: BLEEDING TIME, COAGULATION TIME AND BLOOD PLATELETS *

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With the increasing use of the ultraviolet light as an important therapeutic measure in the treatment of children, it is obviously necessary to ascertain the effect that this procedure has on the blood of the young organism. For this reason the following studies were made, of which this is the preliminary report.

MATERIAL

This study is based on a series of fifty new-born infants. These infants were all of normal delivery, and the mothers had not been subjected to any anesthetic that would interfere with the bleeding time and the coagulation time,[1] which, with the blood platelet count, were taken immediately after birth, and at intervals of twenty-four hours thereafter. At the end of the fourth day, the ultraviolet treatments were begun on alternate infants; thus there were twenty-five normal new-born infants for a control and twenty-five who had received irradiations. These treatments were not given until the fourth day, so that the bleeding and coagulation time would return to a lower value, as Rodda[2] has shown occurs by this time.

METHOD

A slight modification of Rudolf's[3] method was used in this series. The skin of the heel was thoroughly cleansed with green soap and alcohol, and allowed to dry. A deep puncture was then made in the heel, which resulted in a good flow of blood. This was drawn up into two glass pipets about 1 mm. in diameter and 18 cm. in length. The amount of blood drawn up should be approximately 9 cm. in each tube. The time of drawing the blood was noted, and the tubes were immediately put into an incubator (dry heat) at a constant temperature of 20 C. The entire procedure was always carried out in the nursery, which was kept at a constant temperature. At the end of one minute, one of the tubes was removed and a small piece was broken from the end. This was repeated every thirty seconds until a thread of fibrin appeared between the broken ends. The time between the puncture and the appearance of the fibrin was taken as the coagulation time. The second tube was used as a control.

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* From the pediatric and obstetric wards of the Presbyterian Hospital, Chicago.

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2. Rodda, F. C.: Determining Coagulation Time of Blood in New-Born, Am. J. Dis. Child. **19**:269 (April) 1920.

3. Rudolf, R. D.: A Clinical Method of Estimating the Coagulation Time of the Blood, Am. J. M. Sc. **140**:807, 1910.

The bleeding time was taken by the method of Duke.[4] A puncture in the heel was made as described, and the accumulated drop was blotted up by a piece of sterile gauze until no drop formed. The time between the appearance of the blood and its cessation of drop formation is the bleeding time.

Several methods for counting the platelets were tried. Those of Hofmann,[5] and of Wood, Vogel and Famulnes[6] were found to be satisfactory, but finally the solution used by Rees and Ecker[7] was adopted as giving the best results. The blood was drawn to the 0.5 mark in the red counting pipet, and diluted to the 100 mark with the solution described in the foregoing. A fresh solution was used for each count. The pipet was shaken for three minutes, and after expelling the first three drops, the next was put on the counting chamber with Türk ruling. After ten minutes, the platelets were sufficiently settled to count.

The ultraviolet treatments were given by means of a mercury vapor quartz lamp of 50 cycle, 5 amperes and 210 volts. The exposures were directly to the skin at a distance of 30 inches from the body. The head was well protected from the rays, and the initial exposures consisted of one minute each for the entire dorsal and ventral surfaces of the body. It was found that if the initial exposure for the new-born infant was longer erythema would develop. These exposures were increased one minute a day for four days and then stopped, the last exposures, therefore, lasting four minutes each for the entire dorsal and ventral surfaces. The exposures never caused the child discomfort. If the eyes are well protected and opportunity is given for easy breathing, the children will usually sleep throughout the entire proceeding.

Results of Exposure to Ultraviolet Light

	Normal			Ultraviolet Exposure		
Time	Bleeding Time, Minutes	Clotting Time, Minutes	Platelets	Bleeding Time, Minutes	Clotting Time, Minutes	Platelets
Birth	3	4½	250,000			
24 hours	3	4	300,000			
48 hours	3½	4½	280,000			
3 days	4	5	320,000			
4 days	4	6	300,000	Ultraviolet started		
5 days	3½	5	280,000	3	4½	360,000
6 days	3	4½	280,000	2	4	400,000
7 days	3	4	300,000	2	4	410,000
8 days	3	4	300,000	2	4	440,000
				Ultraviolet stopped		
9 days	3	4	310,000	2	4	400,000
10 days	3	4	300,000	2½	4	380,000

COMMENT

It will be observed from the results given in the table that in the normal infant there is no direct relation between the number of platelets found and the age of the child. The platelets are evidently influenced in their fluctuations by circumstances not at present apparent. These

4. Duke, W. W.: The Relation of Blood Platelets to Hemorrhagic Disease, J. A. M. A. **55**:1185 (Oct. 1) 1910.

5. Hofmann, F. B.: Ueber Blutplaettchenzaehlung, Deutsche med. Wchnschr. **52**:861 (May 21) 1926.

6. Wood, Vogel, and Famulnes: Laboratory Technique, New York, J. T. Daughtery, 1922.

7. Rees, H. M., and Ecker, E. E.: An Improved Method for Counting the Blood Platelets, J. A. M. A. **80**:621 (March 3) 1923.

variations were noted by Morse [8] and later by Lucas,[9] and by McLean and Caffey.[10] This, however, is not the case with the infants treated with the ultraviolet light. Here there is an immediate and direct increase amounting to 140,000 platelets in four days, or one third of the total count. This apparently falls to normal after exposure is stopped.

In the infants receiving irradiation there is a decrease of one minute from the normal bleeding time. This decrease is also in direct relation to the increase in blood platelets. Sooy and Moise [11] obtained similar results in an adult suffering from idiopathic purpura.

There was no change in the coagulation time. This is, no doubt, due to the fact that in the organism in which the blood is deficient in calcium, the ultraviolet irradiation will increase this calcium;[12] on the organism with a normal amount of blood calcium the ultraviolet light has no such effect. This has been demonstrated by Lesné and his co-workers [13] and by Reed and Tweedy.[14]

The question arises as to whether this decrease in the bleeding time is due to an increase in the formed elements of the blood, or to some obscure metabolic change. It is known that ultraviolet radiations are capable of acting on the capillary and lymph circulation and on the cells on the surface of the exposed person to induce such actinic or chemical change as to assimilate substances from the blood stream.[15] However, this property of decreasing the bleeding time of the blood is not confined to the ultraviolet light, but is also the property of the roentgen ray.[16] Furthermore, that there has been a direct change in the

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8. Morse, M. E.: The Blood Platelets in Normal Women, in Obstetrical Patients and in the New-Born, Boston M. & S. J. **166**:448 (March 21) 1912.

9. Lucas, W. P.; Dearing, B. F.; Hoobler, H. R.; Cox, A.; Jones, M. R., and Smyth, F. S.: Blood Studies in the New-Born, Am. J. Dis. Child. **22**:525 (Dec.) 1921.

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11. Sooy, J. W., and Moise, T. S.: Treatment of Idiopathic Purpura Hemorrhagica by Exposure to Mercury Vapor Quartz Lamp, J. A. M. A. **87**:94 (July 10) 1926.

12. Huldschinsky, K.: Cure of Rachitis by Means of Artificial Heliotherapy, Deutsche med. Wchnschr. **45**:712 (June 26) 1919. Mitchell, H. S., and Johnson, F.: Ultra-Violet Radiations in Conditions of Extreme Calcium and Phosphorus Deficiency, Am. J. Physiol. **72**:143 (March) 1925. Powers, G. F.: Park, E. A.; Shipley, P. S.; McCollum, E. V., and Simmonds, Nina: Prevention of Development of Rickets in Rats by Sunlight, J. A. M. A. **78**:159 (Jan. 21) 1922.

13. Lesné, E.; Turpin, E., and Zizine, F.: Influence of Ultraviolet Rays on Calcium in Growing Organism, Compt. rend. Soc. de biol. **91**:1378 (Dec. 27) 1923.

14. Reed, C. I., and Tweedy, W. R.: Effect of Ultra-Violet Light on Blood Calcium, Am. J. Physiol. **76**:54 (March) 1926.

15. Tindall, W. J.: Effect of Ultra-Violet Radiation on Metabolism, Mil. Surgeon **59**:186 (Aug.) 1926.

16. Bernhard, F.: Coagulation of the Blood Under Irradiation, Arch. f. klin. Chir. **130**:93 (Aug. 7) 1924.

blood itself has been shown by Pagniez [17] for when the blood supply to a part that was under irradiation was blocked, there was no change in the constituents of the blood in other parts of the body. Laurens [18] has shown that the cellular elements of the blood are influenced by light and darkness, light causing an increase, and darkness a decrease, while De Gheldere [19] has found an increase in the leukocytes after ultraviolet irradiation.

It may be assumed, therefore, that there is a general property in these agents which is capable of increasing the blood elements by means of the platelet increase, thus lowering the bleeding time.[20] In infants suffering from hemorrhagic disease of the new-born and other forms of delayed coagulation and bleeding time, treatment with ultraviolet irradiation would offer a companion therapeutic measure with other accepted methods of treatment.

SUMMARY

Short exposure to the ultraviolet light lowers the bleeding time of the blood in the new-born infant does not affect the coagulation time.

The platelets are increased but not permanently so.

Short exposures to the ultraviolet light would serve as a therapeutic measure in infants with delayed bleeding time, but their coagulation time would have to be decreased by other measures.

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17. Pagniez, P.; Ravina, A., and Solomon, I.: Action of Roentgen Rays in Accelerating the Coagulation of the Blood, Presse méd. **32**:545 (June 25) 1924.

18. Laurens, Henry; and Sooy, J. W.: The Effect of Light and Darkness on the Blood Cell Number of the Growing Albino Rat, Proc. Soc. Exper. Biol. & Med. **22**:114 (Nov.) 1924.

19. De Gheldere, C.: Les variations du nombre globules blancs chez le lapin sous l'influence des rayons ultra-violets, Compt. rend. Soc. de biol. **93**:1533 (Dec. 18) 1925.

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TREATMENT OF EXTENSIVE PULMONARY TUBERCULOSIS WITH ULTRAVIOLET RAYS*

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Even though in recent years various authors,[1] some on the basis of one or two cases, and some [2] with more extensive experience, have called attention to the fact that infants ill with pulmonary tuberculosis can and do recover, the opinion still prevails generally [3] that a hopeless prognosis is in order with tuberculosis once it involves the lungs themselves. This really is not so surprising, when one recalls that not so long ago a positive tuberculin test in an infant was considered to be a dependable sign of a fatal outcome.

The question as to whether these reported recoveries really were cases of pulmonary tuberculosis recently has been made more difficult to answer, principally as the result of the writings of Eliasberg and Neuland,[4] who describe the appearance and the subsequent disappearance, usually within from six to twelve months, of extensive infiltrations in one or more lobes of the lungs of infants giving a positive tuberculin test. These lesions they have designated as epituberculous because they believe they are nontuberculous and nonspecific. According to these authors, the infiltrations which they describe developed so insidiously that, when finally found, they represented a surprise both from the

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* From the Department of Pediatrics, School of Medicine, Western Reserve University, the pediatric wards of City and Lakeside Hospitals, and the Babies and Childrens Hospital.

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2. Hempelmann, T. C.: Am. Rev. Tuberc. **1**:99, 1917-1918. Wallgren, A.: Acta Tuberc. Scandinav. **1**:179, 1925. Moll, L.: Monatschr. f. Kinderh. **28**:58, 1924.

3. Birk, W., and Schall, L.: Strahlenbehandlung bei Kinderkrankheiten, 1924, p. 19. Freeman, R. G.: Arch. Pediat. **39**:489 (Aug.) 1922. Kleinschmidt, H.: Tuberk. d. Kinderh., 1923, p. 74. Nassau, E., and Zweig, H.: Ztschr. f. Kinderh. **39**:484, 1925. Cattaneo, C.: Pediatria **32**:881, 1924. Dunn, C. H., and Cohen, S. A.: The Diagnosis and Prognosis of Tuberculosis in Children, Am. J. Dis. Child. **21**:187 (Feb.) 1921. Gittings, J. C.: Tuberculosis in Infancy and Childhood, Philadelphia, J. B. Lippincott Company, 1922, p. 273.

4. Eliasberg, H., and Neuland, W.: Jahrb. f. Kinderh. **93**:88, 1920; ibid. **94**:102, 1921.

standpoint of the extensiveness of the lesion and from that of the general state of wellbeing of the patient. In their cases the tuberculin tests were found to be markedly positive, and osseous tuberculosis, tuberculous cervical lymph glands and lichen scrofulosorum were frequently found alone or together in these cases. According to these authors, the prognosis is good, even though the pulmonary infiltration remains extensive and unchanged for weeks and months. In two of the cases the infiltrations remained the same for fifteen and eighteen months, respectively, and in another instance the condition began to improve after having been stationary for nine months.

Evidently, if Eliasberg and Neuland are correct in their contentions, then it may be that the good prognosis for pulmonary tuberculosis in infants, reported by the authors mentioned in the foregoing, is not justified.

That the infiltrations observed by Eliasberg and Neuland are specific rather than nonspecific seems probable, as their subjects (as just stated) are very sensitive to tuberculin. It is well known that another allergic and exudative state associated with tuberculosis is similarly characterized by an excellent prognosis.[5] We refer to the condition ordinarily described as scrofula.

Langer [6] reports an experience with a child that is most illuminating, and which strongly indicates that the cases described by Eliasberg and Neuland are specific in nature. After an interval of four years, at the seat of a former rather extensive infiltration of the left upper lobe, which infiltration had entirely disappeared in the meantime, Langer's patient developed a sudden and complete filling up of the same area after a subcutaneous injection of 0.1 mg. of tuberculin. This was accompanied by a continuous, high fever, marked pains in the chest, dulness and diminished breath sounds—an acute picture. Within fourteen days the dulness and the roentgen-ray shadow disappeared. Langer maintains that this experience proves definitely that the first pathologic change observed by him in the lung of his patient was tuberculous in character. Second, that a truly tuberculous process in the lungs of an infant can be absorbed, and third, that the acute exudate into the same area after the injection of tuberculin was specific in nature. Our own experience coincides with that of Langer so far as the absorption of tuberculous pulmonary exudates in infants is concerned, as three of our seven cases at one time showed undoubted cavitation.

Whether an allergic exudate of the type seen by Langer can go on to and through the process of cavity formation without being actually tuberculous in character we cannot state. That this might be possible

5. Nobel, E., and Schönberger, M.: Ztschr. f. Kinderh. **38**:668, 1924. Engel St.: Monatschr. f. Kinderh. **29**:393, 1924-1925.

6. Langer, H.: Ztschr. f. Kinderh. **34**:142, 1922.

should not seem strange when we recall the course of the phlyctenule in a scrofulous child from the stage of vesicle to that of ulcer. It would not surprise us if at some time it is shown conclusively that such massive infiltrations represent a valuable and an important part of a beneficial defensive mechanism on the part of the tuberculous human body. Such an observation would make the favorable prognosis better understood.

It should be realized also that it may be impossible even to differentiate suddenly developing massive allergic exudates from the ordinary lobar or confluent bronchopneumonia. During the course of our observation of case 6 (figs. 11, 12 and 13) we had such an experience. In this instance the beginning of the seemingly intercurrent disease was acute; the fever was high and continuous for five days and then dropped to normal by crisis. The white count was 31,000, and the roentgenogram on the fourteenth day showed that the dense shadow had disappeared. Whether this infiltration was a tuberculous allergic reaction, or whether it was nontuberculous pneumonia it is impossible to say. We were inclined on the basis of the white count at the time of observation to diagnose the condition as nontuberculous lobar pneumonia. At the present time, however, we are not at all certain that this was not an allergic exudate similar to the one observed by Langer in his patient, and similar to those since reported by Henius.[7] It is interesting to note that three weeks later this patient developed measles, without the accepted subsequent extension of the pulmonary tuberculous process.

However, Eliasberg and Neuland maintain that truly tuberculous exudates, that are of the extensiveness of their cases, have a violent onset, make the patient very ill, are not absorbed and go on to caseation and often to cavitation and death. In other words, they are of the opinion that the prognosis of such tuberculous subjects must be bad, and they argue that, because the general condition and the prognosis in their cases is good, the changes observed by them in the lungs of tuberculous patients cannot be tuberculous in character nor even specific in nature. We feel that these tenets cannot be held any more, in view of the experience of Langer,[6] that of other authors [8] and of ourselves. We feel justified in considering all of the exudates that persisted in our cases for months to be at least specific in character. Whether all of them were actually tuberculous is impossible to state. Those, however, that proceeded to the stage of cavity formation in the light of the present knowledge surely must for the time being be considered tuberculous.

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7. Henius, C.: Klin. Wchnschr. **5**:712, 1926.

8. Epstein, B.: Jahrb. f. Kinderh. **99**:59, 1922. Grävinghoff: Monatschr. f. Kinderh. **21**:447, 1921. Engel, St.: Berl. klin. Wchnschr., 1921, p. 877. Armand-Delille, P. F.: Isaac-Georges, and Ducrohet: Presse méd. **31**:537, 1923.

In addition to the seven cases reported in this article, we observed another patient whose extensive involvement of the lung markedly improved while under observation. This infant also had tuberculous lesions in the bone and soft tissue which persisted. She died suddenly in an unexplained manner. Permission for necropsy was not obtained, but the roentgenogram registered very definite improvement in the lung.

We have treated other patients with pulmonary tuberculosis who came to us in a serious state, and showed lesions in both lungs, which, according to the roentgenogram, principally followed the bronchial or vascular tree or were miliary in character. On the whole, these patients usually died soon, and either with the diagnosis of miliary tuberculosis or with that of extensive bilateral peribronchial tuberculosis. Whether these cases were too far advanced, whether the fact that the process was present in both lungs and was general in distribution, or whether the miliary character of the tuberculosis was responsible for the poor results, it is impossible to state.

It is our impression, however, that lesions that are massive in character and lobar in distribution are the ones that respond to treatment or recover spontaneously and give a favorable prognosis. This impression is so strong that we have asked ourselves the question whether the massive exudates—and it is impossible to say, even though they are limited to one lobe, whether they are lobar infiltrations or pseudolobar in type, i. e., a conglomerate bronchopneumonia—are not a part of a general immunologic attack of the body against the tubercle bacillus, rather than the result of local irritation of the tissue by the tubercle bacillus.

It should be mentioned here that various authors, especially French and Italian,[9] have expressed the opinion that the condition described by Eliasberg and Neuland is the same as that previously recognized as a "splenopolmonite del grancher" or "splenopneumonia or pneumonie massive." For detailed information regarding our own cases, the appended case histories, charts and roentgenograms should be consulted.

In a previous communication, one of us [10] has reported favorably on the nonspecific but decidedly beneficial effect of the ultraviolet ray as produced by the mercury quartz arc, on peritoneal and glandular tuberculosis, and adversely on pulmonary lesions of the miliary type. Our experience has not changed in this regard. Consequently we were much surprised when the first patient of this series, M. M., did not become worse, and actually recovered while being treated with mercury quartz

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9. Capite, A. De: Pediatria **31**:881, 1923. Koch, W.: Monatschr. f. Kinderh. **29**:303, 1924-1925.

10. Gerstenberger, H. J., and Wahl, S. A.: Ultraviolet Ray Therapy in Peritoneal and Glandular Tuberculosis of Children, J. A. M. A. **83**:1631 (Nov. 22) 1924.

ultraviolet rays. Before this method of treatment was instituted the patient had been in bed at rest for six months, and had received a wholesome diet containing enough milk, orange juice and cod liver oil. Soon after admission to the hospital he improved, but only temporarily. He got much worse, lost weight, had high fever, developed a phlyctenular conjunctivitis and an exudate into the peritoneal cavity. The whole picture changed soon after the quartz lamp therapy had been started. It is true that he had been gaining in weight again two weeks before the actinic ray therapy was begun and, therefore, it is impossible to say whether or not he would have continued to improve. However, he had improved and had gained in weight similarly on a number of previous occasions, only later to become generally worse. Consequently we have the distinct impression that this patient was benefited by the use of the quartz lamp. At any rate, we can be positive that no harm was done, as his gain in weight, the improvement in his general condition, the disappearance of fever and the gradual clearing up of the lung exudate from this time on were remarkable in degree and in constancy (figs. 1 and 2).

This experience encouraged us to treat additional cases of pulmonary tuberculosis. In order to make possible an attempt at the evalution of the therapeutic powers of the actinic rays, the patients were exposed only to the quartz mercury arc lamp and were kept in bed and indoors; in other words, exposure to outside air, sunlight or to the carbon arc light was avoided in each instance. Whether the rays produced by the carbon arc are superior in the treatment of tuberculosis to those of the quartz mercury arc we do not know. We are convinced, however, that those who deny that the actinic rays have any therapeutic value in tuberculosis are in error. The experience that we had in treating tuberculous peritonitis and tuberculosis of the mesenteric glands with a quartz lamp, as previously reported, is primarily responsible for this conviction, as it was easier in these cases to judge and to follow the improvement obtained than it has been in patients ill with pulmonary involvement.

Case 5 (D. T.) is the one case in which it might be maintained that the ultraviolet ray therapy did no good and possibly did some temporary harm. On this patient's admission, at the age of 2 months, with a weight of 2,500 Gm., the tuberculin test was positive, but only to a 0.1 dilution. The roentgenogram was practically negative, although in the left upper side of the chest a faint haziness was present, quite similar to that produced by a former attack of pleurisy. Three weeks after admission, a slight mottling in the right upper lobe appeared. At this stage the quartz lamp therapy was begun. Two months later, an infiltration that was dense and extensive was found in the right upper lobe. In two additional months a cavity appeared in the center of this area. The exposure to the quartz lamp was continued nothwithstanding, and in

another two months the cavity had disappeared and the area of consolidation had been reduced in size but was more dense. Later on, the lung area cleared entirely leaving, however, as is so frequently the case, a rather large mass of bronchial and peritracheal glands.

Whether the quartz lamp hurried the infiltration and cavitation, and whether this was good for the patient or not, we cannot state. We do know, however, that the temperature became normal immediately after the cavity appeared and that the final end-result was excellent (figs. 9 and 10). Consequently, we are convinced that at least no harm was done.

In cases 2, 4, 5 and 6 (figs. 2 and 3; 7 and 8; 9 and 10; 11, 12 and 13), the lung fields were clear at the end of one year, and in case 1 (figs. 1 and 2), at the end of two years. In case 3 (figs. 5 and 6) there was still slight cloudiness at the end of one year, and in case 7 there remained at the end of this time in the right upper hilum region a dense shadow which was not entirely due to enlarged glands and which looked like a small mass of much shrivelled lung tissue (figs. 14 and 15).

In the cases in which the lung fields cleared best, the peritracheal and bronchial glands were largest at the end of the observation. What significance, if any, is to be attached to this observation we do not know. In this connection, however, it should be mentioned that Kleinschmidt (footnote 3, p. 53, third reference), has offered a theory for the mechanical development of exudates in the lungs as a result of obstruction to the glands which are supplied by that area. Case 6, in addition, showed a slight widening of the hilum shadow on the opposite side, and in case 3 the hilum shadow on the right side was somewhat widened and sharpened.

The ages of the patients on admission were as follows: 2, 5, 6, 10, 13, 16 and 17 months, respectively.

The left upper lobe was involved in two cases, the right upper lobe in three, the right and left lower lobes in one, and in one case the shadows were not very dense and followed the bronchial tree on both sides, radiating out from the hilum regions. All three of the right upper lobe cases reached the stage of cavity formation.

In four cases the 1 : 1,000 intracutaneous tuberculin test was 3 + positive. Two of these patients developed a tuberculous peritonitis, and one presented a cavity in the right upper lobe in addition. In one case the 1 : 1,000 intracutaneous tuberculin test was 1 + positive. This patient also had a cavity in the right upper lobe. A sixth patient had a 1 + positive 1 : 100 intracutaneous tuberculin test, and a seventh patient a 1 + positive 0.1 intracutaneous tuberculin test. The last patient was the third to go to the stage of cavitation.

From these observations it is evident that there existed no correlation in our cases between the degree of sensitiveness to the tuberculin test and the extensiveness of the tuberculous process in the lung. Both patients

who developed a tuberculous peritonitis possessed a marked degree of sensitiveness to the tuberculin test, notwithstanding that one of them had a large cavity in the right upper lobe. One of these also developed a phlyctenular conjunctivitis.

It is interesting to note that, on admission, all of our patients except one were in a poor state of general health and of nutrition, and that, notwithstanding, all gained in weight at a satisfactory rate once continuous improvement had begun, except one patient (case 7), who was so sick that it was not believed that he possibly could recover. However, although his weight curve does not compare favorably with that of the others, the change for the better that developed in his disposition and his attitude toward his environment was outstanding.

It will be noted that all of the patients except those in cases 3 and 6 received cod liver oil in some form in their diet (cod liver oil, Protein S.M.A.). In case 6, the cod liver oil intake in the form of Protein S.M.A. did not begin until three months after admission. Ultraviolet therapy had been instituted since the first day, and the improvement in general appearance, in the weight curve, in the physical characteristics and in the roentgenograms had begun before the food containing cod liver oil was given. In case 3, no cod liver oil was given, and the ultraviolet therapy was not begun until the beginning of the sixth month in the hospital, at which time the weight curve remained practically stationary for a month, and the roentgenogram showed an extension of the infiltration of the tissue of the lungs on both sides. Before the one month of stationary weight, the infant had gained fairly well in weight, even though at one time he was moderately dehydrated.

COMMENT

We are of the opinion that while the rest in bed, the completeness of the diet and the addition of cod liver oil were of value in improving the state of nutrition of the infants, they were not entirely responsible for the final successful outcome in these cases. We appreciate that no adequate proof can be given concerning this point, but it has been our impression in each of these cases that the exposure to the ultraviolet rays was of value, especially in that it brought about a change of disposition in the patient, and that it made more consistent and more persistent the progress toward recovery, probably by enabling the human body, in some nonspecific manner, to be in a better condition to win its own fight against the disease. At any rate no demonstrable harm was done, and the improvement occurred without the aid of outside air, sunshine or light spectra containing longer rays than those produced by the mercury quartz lamp, even though the lungs were extensively involved and the

11. Czerny, A.: Arch. f. Kinderh. **60-61**:242, 1913.

patients poorly nourished infants. Whether improvement could have been brought about sooner by the use of any or all of these other therapeutic measures, of course, is another question, which we are not prepared to answer at this time. The experience of Czerny,[11] when he found that children when exposed to sunlight in closed glass verandas did not do as well as those who were exposed to sunlight in the outside air, and did no better than other tuberculous subjects housed in the ordinary fashion in the remainder of the hospital, probably corroborates our impression that the actinic rays, which in the patients treated in the glasshouse by Czerny were excluded from action, have a definite therapeutic value in cases of tuberculosis.

The experiences obtained with these cases force us to agree with Kleinschmidt (footnote 3, p. 54, third reference), Epstein,[8] Grävinghoff (footnote 8, second reference), Engel (footnote 8, third reference) and others, that the clinical method suggested by Eliasberg and Neuland for differentiating between a tuberculous or a nontuberculous, massive, pulmonary infiltration is not satisfactory or dependable. Some of our cases went to the stage of cavitation; some did not. The cavities were all located in a dense right upper lobe. We believe we are forced to accept, in the light of our present knowledge of the subject, that these at least were tuberculous in nature, and yet, as was stated earlier in this article, it does seem possible to us that even cavitation might represent a stage of a successful, specific, immunologic process or allergic reaction producible by certain types of human bodies in their fight against the tubercle bacillus.

In scrofulous children, after an intracutaneous injection of tuberculin in a 1 : 1,000 dilution, we often have seen the development of a severe local tuberculin reaction, with marked infiltration and exudation of the skin and with rather extensive necrosis in the center at times. On such a basis pulmonary lesions such as we have seen in our patients, and such as Eliasberg and Neuland and others describe, may be stages of one and the same process and belong to the group of lesions that some still persist in calling scrofulous.

CONCLUSIONS

1. Tuberculous infants showing extensive pulmonary infiltration, even with cavity formation, may recover. Seven cases, covering an observation period of from one to two years, are reported.

2. It seems from the experience obtained in these infants that pulmonary exudates that are massive in character and lobar in distribution especially are inclined to improve. The relation of the lesions in our patients to the epituberculosis of Eliasberg and Neuland and the splenopneumonia of the French and Italian writers is discussed.

3. The question is raised whether the good results obtained in the type of cases reported is not due principally to the fact that such infiltrations are a part of a beneficial immunologic attack of the body against the tubercle bacillus, rather than that they are the results of the local success of the tubercle bacillus.

4. All of the reported patients in the cases were exposed at least three times a week to the quartz mercury arc lamp, and it is our impression that they were benefited thereby. It is certain that no harm was done.

REPORT OF CASES

CASE 1.—M. M., a colored boy, aged 16 months, was admitted to the City Hospital, Oct. 15, 1923.

History.—For the past month the patient had suffered with a cough, and for two weeks had had an elevation of temperature in the afternoon. He had lost weight. The previous history was unimportant. A roomer in the infant's home had died from pulmonary tuberculosis three months previously.

The infant did not appear very ill, and the physical examination showed only slightly impaired resonance and moist râles at the left base posteriorly. The 1 : 1,000 intracutaneous tuberculin test was markedly positive. The roentgenogram, contrary to the physical examination, showed a rather dense infiltration at the right base with some infiltration on the left.

The child gained in weight after admission, and was happy and contented. There were several periods of fever lasting for a week or ten days, but the physical examination revealed about the same condition.

During January, 1924, three months after admission, a phlyctenular conjunctivitis appeared. A little later an ulcerative stomatitis was discovered. This was the beginning of a downhill course which lasted for more than two months. There was marked loss in weight, the food was refused, the stools were loose, and the patient looked extremely ill. There were definite signs of infiltration in both bases. Early in April, fluid was present in the peritoneal cavity. At this time it did not seem that there was much hope of recovery. However, the patient began to take his food, gained in weight and there was a change in the general appearance. The upward trend of the weight curve had been present for a week when quartz lamp irradiation was started on alternate days. Improvement in the general condition continued for several months. The chest condition, however, showed little change for nearly six months. The temperature gradually came down to normal. In the autumn of 1924 the general appearance and activity were those of a normal child, although according to roentgen-ray and clinical examinations there was still considerable involvement of both bases. There was little of interest from then until his discharge in September, 1925, except an occasional exacerbation of the phlyctenular conjunctivitis. On discharge in September, 1925, occasional râles could still be heard at the left base, although the general condition was good and a roentgenogram showed an absence of involvement of the lungs.

The diet consisted of whole milk, cereals and vegetables; one teaspoonful of cod liver oil was given three times a day.

CASE 2.—L. B., a colored boy, aged 17 months, was admitted to Lakeside Hospital, March 13, 1924.

History.—The child had been weak and had seemed ill for the past three weeks. He refused food. Recently, he had had an attack of diarrhea lasting for several days. The patient had always been weakly, and had had a large abdomen since birth; he was breast fed for thirteen months, but had never received orange juice or cod liver oil. His mother had a bad cough.

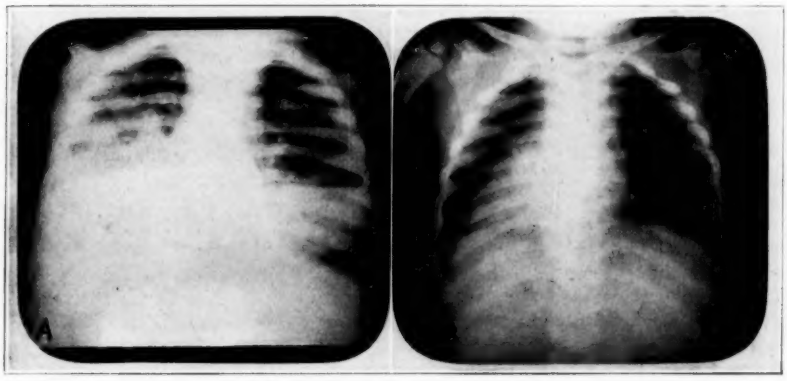

Fig. 1 (case 1).—*A*, the patient is markedly emaciated, with fluid in the abdominal cavity. Dense infiltration of both bases is seen. *B*, the same patient eighteen months afterward. The general appearance is that of a normal child of his age. A few râles are present in the left base. The lung fields are clear except at the left base, where a little cloudiness is still present.

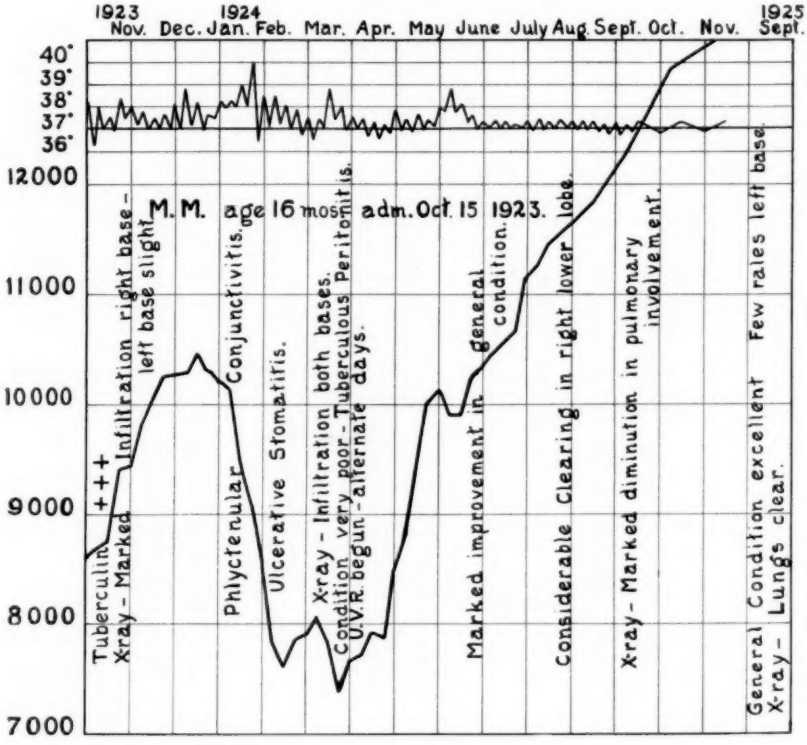

Fig. 2.—Temperature and weight chart of patient 1.

Physical Examination.—A poorly developed and markedly malnourished child, with clinical evidence of advanced rickets, was seen. The right upper lobe showed diminished resonance, and bronchial breathing was present. There were a few crepitant râles here and in the right base. The abdomen was enlarged and a fluid wave was present. The 1:1,000 subcutaneous tuberculin test was positive. A roentgenogram showed consolidation of the right upper lobe with cavitation. A few days after admission the peritoneal cavity was entered with a capillary tube, and slightly turbid amber fluid was obtained. This was sterile on culture. The diagnosis at this time was "rickets, "pulmonary and peritoneal tuberculosis."

The temperature during this period rose to about 39 C. (102.2 F.), and the child appeared quite ill. The physical signs changed little during the first six weeks, and the patient gained practically none at all. Because of a varicella epidemic he was sent to the contagious department of the City Hospital from April 25 to May 20. On his return the pulmonary signs were about the same, but there was no evidence of abdominal fluid. The rickets had almost healed. On May 30, ultraviolet irradiation was started and given daily. This was followed by marked general improvement and a steady gain in weight, averaging from 5 to 8 ounces weekly. The cavity was less distinct on the roentgenograms during June, and was no longer visible in August. In October, the patient was again transferred to the contagious hospital because of suspected pertussis. In February, 1925, the general condition was excellent. There was a slight dulness in the right intrascapular region with the breath sounds higher in pitch. No râles were heard. A roentgenogram now showed a dense, sharply defined shadow extending into the right upper and middle lobes. The remainder of the right upper lobe was hazy, but much less dense than on previous examination.

The diet consisted of protein S. M. A. and carbohydrate; farina and vegetables were started in August, 1924.

CASE 3.—V. M., a colored girl, aged 5 months, was admitted to Lakeside Hospital, June 9, 1924.

History.—A paroxysmal cough and fever had been present for one week prior to examination. The parents had been treated for syphilis; there was no history of tuberculosis.

Physical Examination.—The patient appeared markedly undernourished; there was a seropurulent nasal discharge present. The percussion note was elevated over the left apex and base. Breath sounds were diminished over the entire left side, with high pitched breathing, bronchophony and showers of râles at the angle of the scapula. A few râles were present on the right side. The spleen was palpable. The intracutaneous tuberculin test was positive, 1:100 dilution. The Wassermann reaction of the blood was negative. A roentgenogram showed a mottling radiating from the lung roots, and the roentgenologist made the diagnosis of enlarged hilum glands. Cultures from the nose showed diphtheria bacilli. The patient was transferred to the contagious department of the City Hospital, where the tuberculin test was again reported as positive. Râles were present in the left upper lobe and right axilla. Early in July, an acute process appeared in the right base which was diagnosed as nontuberculous bronchopneumonia, but which, in retrospect, may have been tuberculous. The temperature was as high as 39 C. (102.2 F.) for five days, and then continued to about 38 C. daily for the remainder of the month. Loss in weight occurred, necessitating hypodermoclysis. During August and September there was considerable gain in weight with improvement in the clinical conditions. The temperature, however, averaged about 1 C. above normal. The clinical observations were restricted mostly to the right base. During October and early November, the weight curve slackened and elevation of temperature was present. A few days after the temperature had become normal the weight improved, and thinking that these improvements would not continue, we began ultraviolet therapy on November 12 and gave it on alternate days. The clinical improvement continued; it probably occurred too soon to be credited to the ultraviolet treatment. Following an intracutaneous tuberculin test with 1:100 dilution, the patient developed a little

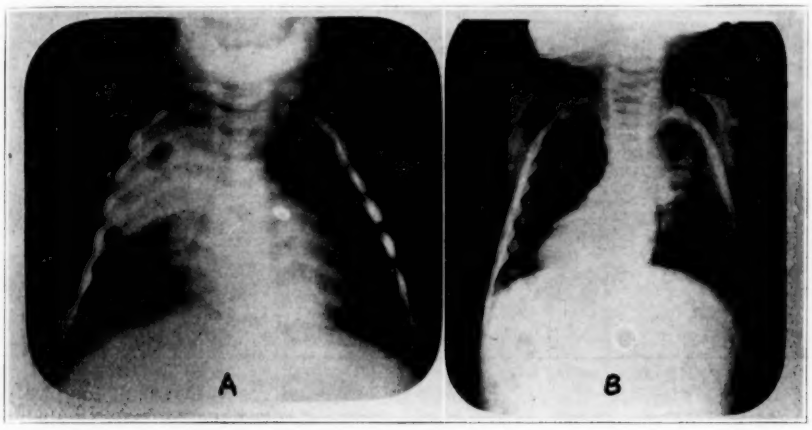

Fig. 3 (case 2).—*A*, consolidation of the right upper lobe with cavitation is noted. Fluid is present in the abdominal cavity. *B*, the same patient ten months afterward. The right upper lobe is clear except for slight haziness due to the thickened pleura. The sharply outlined rounded mass is due to enlarged peritracheal and bronchial glands.

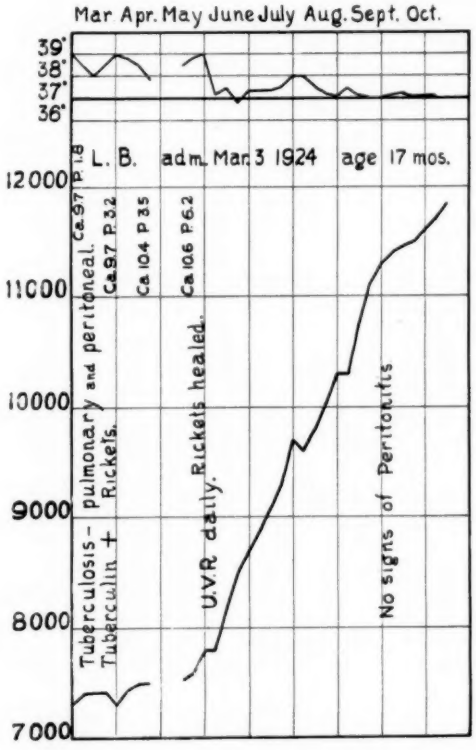

Fig. 4.—Temperature and weight chart of patient 2.

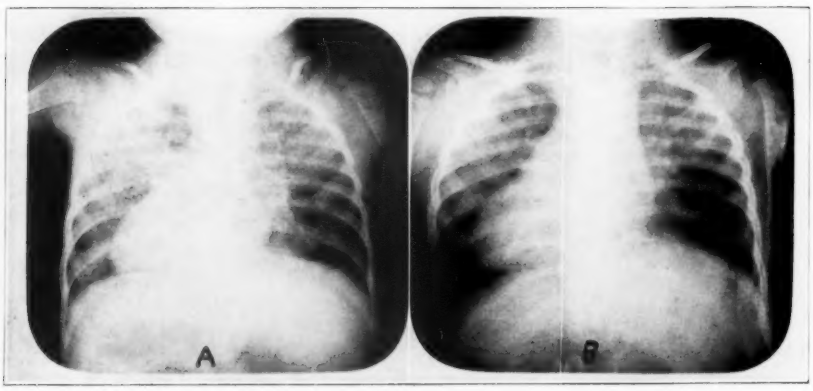

Fig. 5 (case 3).—*A*, a diffuse mottling extending out from both lung roots involving both apexes and the left base is seen. *B*, the same patient five months afterward. A considerable diminution in the pulmonary infiltration but not to a degree comparable to the physical observations is noted.

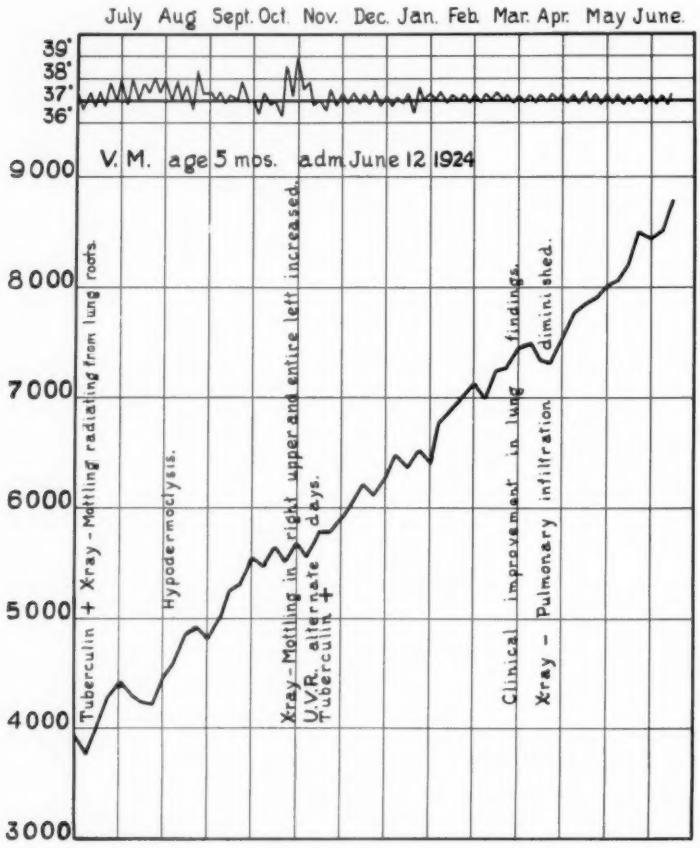

Fig. 6.—Temperature and weight chart of patient 3.

fever and scattered moist râles throughout the chest. Moisture was also present during December, with fine crepitant râles in the right upper portion anteriorly and the base posteriorly. Breathing at this time was again definitely asthmatic in type as it had been in August, when for some time papulovesicular lesions appeared on the skin. No improvement occurred after the use of atropine. Nothing of particular interest occurred from this time until the patient was discharged.

This child, we believe, principally had tuberculosis of the bronchial glands, with a moderate infiltration of the lung parenchyma near the hilum. This case shows a type of involvement that is different from any in the series. A roentgenogram showed a distinct improvement, but not to the same degree as did the clinical observations.

The diet consisted of casein milk for the first four months; lactic acid milk for the remainder of the time, with cereals and vegetables. No cod liver oil was given.

CASE 4.—B. H., a colored girl, aged 6 months, was admitted to the City Hospital, Aug. 12, 1924.

The patient's mother had died of tuberculosis two weeks previously; other history was not obtainable.

Physical Examination.—The patient was fairly well nourished, and on examination showed only slight impairment of resonance with harsh breath sounds at the left apex. The intracutaneous tuberculin test was markedly positive (1:1,000). A roentgenogram showed a dense shadow extending out from the hilum into the left upper lobe. Within the next two months the physical signs were more definite, and râles were heard occasionally. A roentgenogram then showed infiltration of the lung parenchyma of nearly the entire upper lobe. However, this patient never appeared very ill and gained well in weight, except during November, at which time the roentgenogram was unchanged. Except during several upper respiratory infections, the temperature ranged little above 37 C. (98.6 F.). The patient remained in the hospital for about fourteen months. Later roentgengrams showed a mass coming from the hilum which undoubtedly was a tuberculous gland, but the lung parenchyma was nearly clear. Ultraviolet therapy was started ten days after admission, and was given on alternate days until the patient was discharged.

The diet consisted of protein S. M. A. with karo, plus cereals and vegetables during the latter part of the stay in the hospital.

CASE 5.—D. T., a white girl, aged 2 months, was admitted to the City Hospital, Aug. 21, 1924.

The patient's mother had died of tuberculosis recently. The child had shown a positive intracutaneous tuberculin test in the dispensary. Except for malnutrition the physical examination was negative on admission. The weight was 2,500 Gm. The tuberculin test was positive, although it was necessary to use a 1:10 dilution before a good reaction was obtained. A roentgenogram of the chest was negative, but was slightly cloudy in the left upper side, as if a former attack of pleurisy had left its marks. The temperature showed daily variation of from 1 to 2 C., with a tendency to be subnormal. In the middle of September, a roentgenogram showed some mottling in the right upper lobe with thickening of the interlobar pleura. On the basis of the positive tuberculin test, quartz lamp therapy was instituted at this time.

The patient gained in weight rather slowly. Three months after admission, a roentgenogram showed a consolidation of part of the right upper lobe. In January, 1925, about five months after admission, this consolidation was more extensive and a cavity was present in the central portion. In March, the infiltration was more dense but less in extent, and the cavity had disappeared. During the spring and summer, the clinical condition improved and the lung involvement diminished. The patient was discharged in October, 1925. Although she was somewhat less than the normal weight for her age, the general appearance was

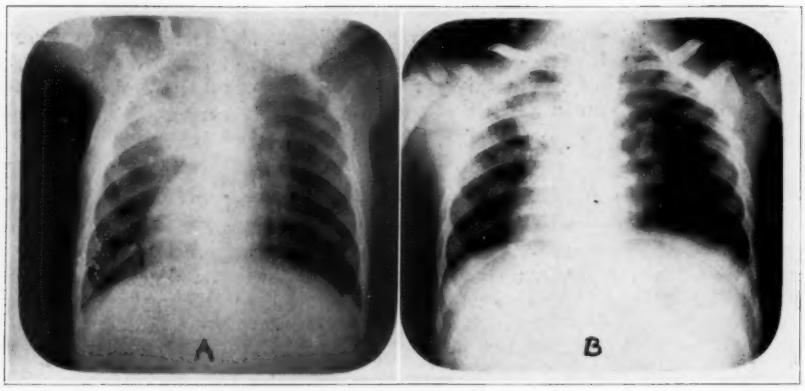

Fig. 7 (case 4).—*A*, infiltration of the left upper lobe more dense near the lung root. *B*, the same patient at the age of 19 months. The left upper lobe is clear. The dense shadow in the left upper hilum region is due to enlarged peritracheal and bronchial glands. This is similar to the final condition.

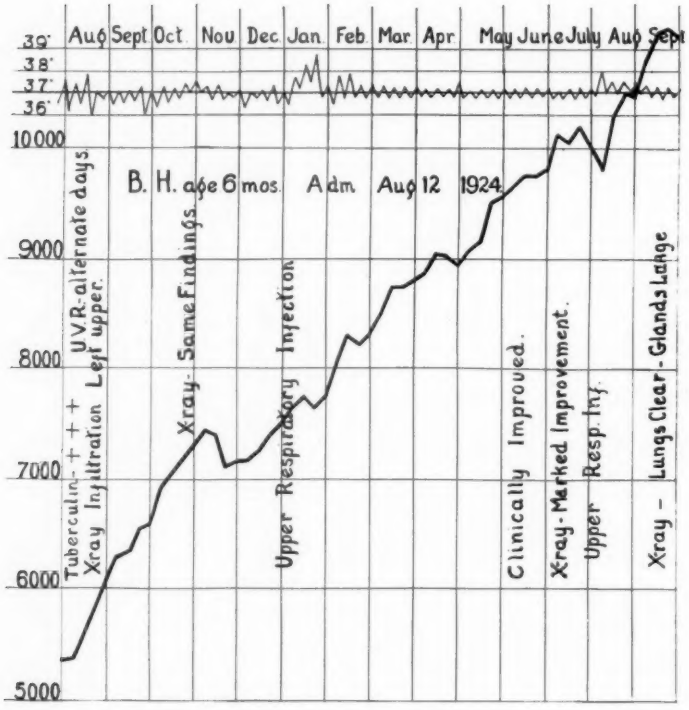

Fig. 8.—Temperature and weight chart of patient 4.

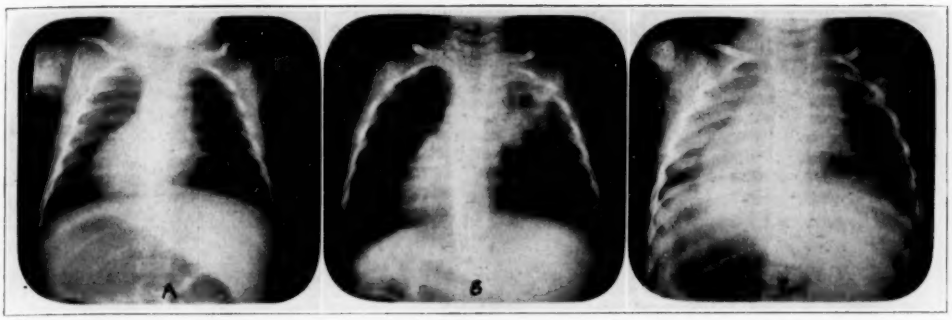

Fig. 9 (case 5).—*A*, slight haziness, as if from an old pleurisy, is present in the left apex, and to a lesser extent in the right. *B*, the same patient at the age of 7 months. Signs of consolidation of the right upper lobe have been present for three months. A cavity in the center of the infiltrated area may be seen. *C*, this plate was taken during expiration and perhaps conveys a wrong impression as to the amount of involvement. The shadow extending out from the right hilum region is probably due to enlarged bronchial and peritracheal glands, but also in part may be due to an enlarged thymus.

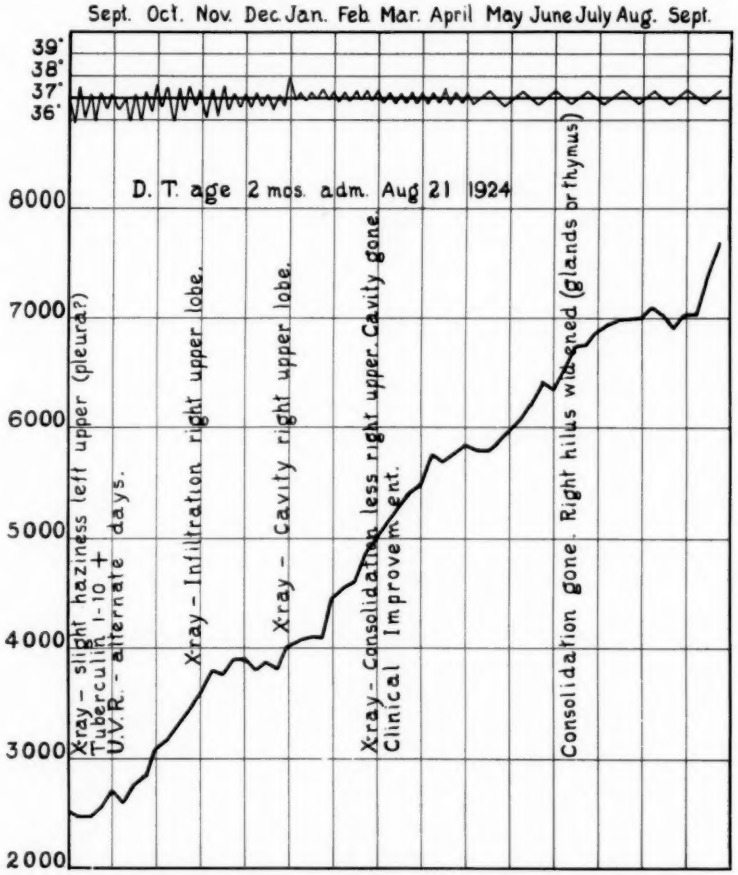

Fig. 10.—Temperature and weight chart of patient 5.

good and there had been no clinical evidence of pulmonary involvement demonstrable for several months.

The diet consisted of double strength S. M. A., 2; skim milk, 1; water, 1; later, S. M. A., with cereals and vegetables for the last few months.

CASE 6.—J. P., a colored girl, aged 13 months, was admitted to Lakeside Hospital, Jan. 22, 1925.

History.—The diagnosis on admission was rickets and a retropharyngeal abscess. There was a history of frequent colds, and the right ear had been discharging for six weeks. A maternal aunt was known to be suffering from tuberculosis.

Physical Examination.—The patient was undernourished, with physical signs of consolidation in the upper lobe which were confirmed by roentgen-ray examination. The intracutaneous tuberculin test was positive in 1:1,000 dilution.

After the retropharyngeal abscess was drained the temperature showed only a slight daily elevation; dulness, bronchial breathing and a few fine râles appeared in the right upper lobe. The temperature remained high for five days, and then dropped by crisis. The white count at that time was 31,000. The condition was believed to be a nontuberculous lobar pneumonia. In fourteen days the shadow in the roentgenogram had disappeared. The temperature then remained about normal until April 22, when an elevation marked the onset of measles. The patient was then transferred to the City Hospital. The roentgenogram at that time showed considerably less density in the left upper lobe, and in the next six weeks there was further clearing up. Dulness and râles were present in both apexes, and persisted for more than a month.

At the time of the patient's discharge from City Hospital on June 6, the infiltration of the left apex had practically disappeared, only a slight haziness remaining in the roentgenogram, and also a rounded shadow extending out from the hilum on the left, due to a mass of bronchial glands. The child was discharged from City Hospital against advice. She reported then to the babies' dispensary and received ultraviolet exposures daily for about one month. In August she spent a total of seven and one-half hours in the sunshine clinic. She then disappeared until readmission to City Hospital, Nov. 12, 1925. The intracutaneous tuberculin test was still positive. Occasional râles were heard at the base. The roentgenogram showed marked clearing of the lung fields over the previous condition, but there was a dense shadow extending outward from the left hilum region. The patient at this time was in an excellent state of nutrition and did not appear ill. The course from this time was uneventful, with a slow gain in weight and an average daily temperature of about 37.5 C. (99.5 F.). From a period shortly after the last admission, the lungs were normal on physical examination. Ultraviolet therapy was maintained until the patient was discharged, March 25, 1926. Although weighing less than 6,000 Gm. at the age of 13 months, at the end of the next twelve months she weighed 13,000 Gm.—a gain of 7,000 Gm.—which enabled her to reach the normal average weight for her age.

The diet consisted of casein plus 9 per cent karo for the first three months. After that protein S. M. A. plus karo, cereals and vegetables was given.

CASE 7.—R. C., a white boy, aged 10 months, was admitted to the City Hospital, June 13, 1925, with the complaint of "cough."

History.—The infant had been normal for the first four months of life. For the past six months he had been coughing and had failed to gain in weight. He had been entirely breast fed. The father died of tuberculosis two weeks previous to the infant's admission to the hospital.

Physical Examination.—The patient was decidedly malnourished; a papular rash was present on the face, neck and body. Examination of the chest revealed a slightly higher pitched note in the right upper lobe, with numerous fine and medium moist râles throughout the chest. The roentgenogram showed a consolidation of the right upper lobe, with a cavity in the central portion. The intracutaneous tuberculin test was positive in a 1:1,000 dilution.

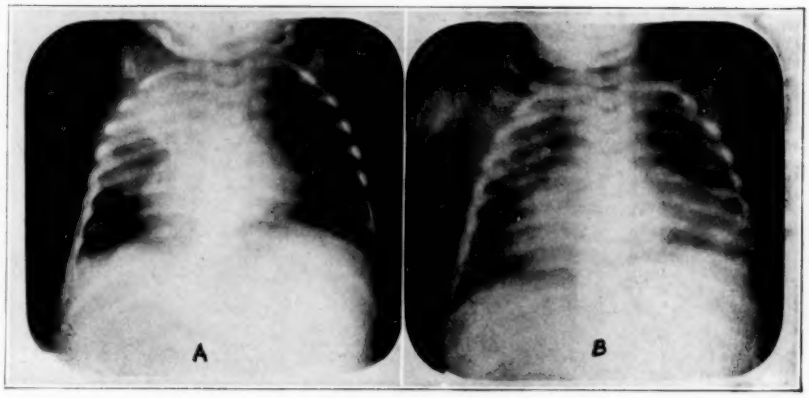

Fig. 11 (case 6).—*A*, the left upper lobe shows consolidation. *B*, this plate was taken at the end of a five day period, during which the temperature was maintained at approximately 40 C. In addition to the previous observations, a fairly uniform infiltration of the right lower lobe may be noted. The clinical picture was that of a patient with active nontuberculous lobar pneumonia.

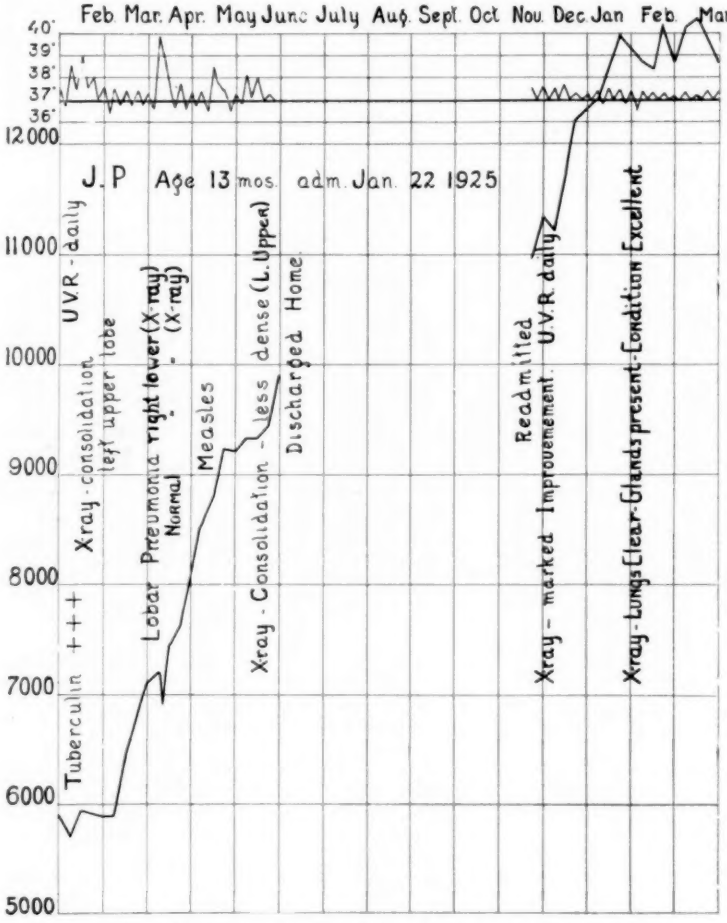

Fig. 12.—Temperature and weight chart of patient 6.

Fig. 13 (case 6).—*C*, nine days after the previous plate (fig. 11) and eight days after the sudden drop in the temperature. The process in the right lower lobe has disappeared. *D*, five months after the first plate (fig. 11). Only very slight haziness remains in the left upper lobe, with a dense mass due to enlarged peritracheal and bronchial glands in the left upper hilum region.

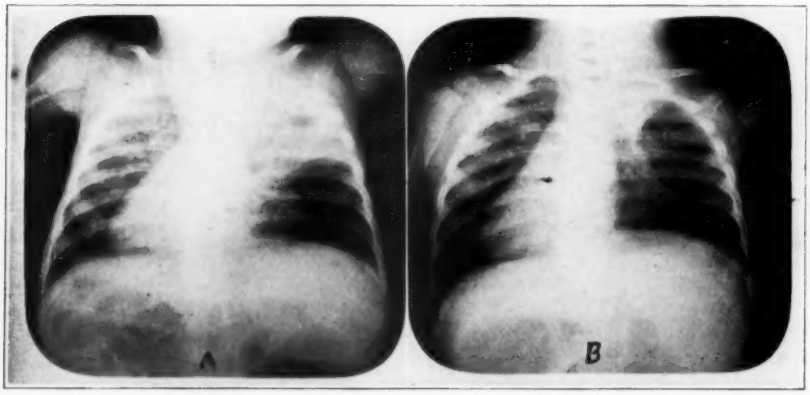

Fig. 14 (case 7).—*A*, the chest shows dulness with moisture at the right apex. A cavity in the center of the densely infiltrated right upper lobe may be seen. *B*, the same patient at the age of 20 months. Absence of the cavity and a marked diminution in the extent of the lesion, the residue being very dense, may be noted.

The infant seemed to improve after being admitted to the hospital; he gained in weight and the moisture disappeared from his chest. Then bilateral otitis media developed during July. Early in August he began to refuse feedings and lost considerably in weight. The roentgenologic observations were practically the same as on admission. Ultraviolet irradiation was started on August 15. There was no immediate improvement, and early in September he appeared extremely ill. The loss in weight had continued. He was extremely irritable and perspired profusely most of the time. Râles were again present in the lungs, and we did not believe that the child could possibly recover. Ultraviolet exposures were then given daily. Within one month clinical improvement was marked, although it was six weeks before a steady gain in weight occurred. A roentgenogram showed about the same amount of consolidation, but the cavity was no longer present.

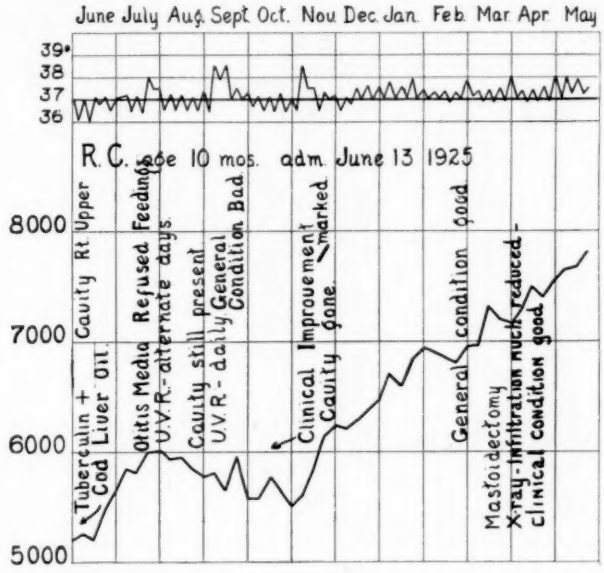

Fig. 15.—Temperature and weight chart of patient 7.

Except for slight dulness there were no abnormal observations on examination of chest. Improvement continued throughout the winter; the gain in weight was slow, but the general picture was entirely different from that in the fall. From an extremely irritable infant who cried when the physician approached his bed, he changed to a smiling, happy infant who seemed disappointed if he was passed by during rounds.

Occasional upper respiratory infections caused temporary setbacks. The right ear continued to discharge. In April, 1926, signs of mastoid involvement occurred, and a mastoidectomy was performed which healed without difficulty. Examination of the chest during the last few months revealed no abnormality, although the roentgengram still shows some infiltration of the right upper lobe, which is, however, less extensive than it had been previously.

The diet consisted of half milk and half oatmeal water, with cereals, vegetables and cod liver oil for the first three months; after that, double strength S. M. A., skim milk with cereals and vegetables were given.

UNRECOGNIZED EMPYEMA OF ONE YEAR'S DURATION

REPORT OF A CASE *

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NEW YORK

It is relatively uncommon for empyema of the thorax to go unrecognized for long periods of time following a primary pneumonia. In the case presented, one year elapsed between the original infection and the recognition of the existing empyema.

REPORT OF CASE

History.—R. C., a boy, aged 6 years, was brought to the outpatient department of the New York Nursery and Child's Hospital on Oct. 30, 1925. He had been directed there by a settlement worker, who, preparatory to sending the boy to the country, wished to rule out an underlying tuberculous condition.

In the family history tuberculosis was absent. The birth, feeding and developmental history were normal. The patient had measles at the age of 3; he had not had any other exanthemas or pertussis. He was troubled often with colds, which persisted even after tonsillectomy was performed two years previously. He was never seriously ill until November, 1924, when he had pneumonia and was confined to bed for three weeks, since which time he had never fully recovered. To his mother, the outstanding characteristic following the pneumonia was the change in his disposition. Instead of being playful as he had been, he now kept to himself, showed a lack of interest in his environment, was easily tired and slept more than formerly. He coughed occasionally but with rare and never purulent expectoration. There was no hemoptysis. He had occasional night sweats. His appetite was poor, although he had lost but little weight since his illness. During this period he had several febrile attacks lasting a day or two. He vomited at times. He showed a tendency to favor the right side. An important point in his history and one which probably influenced the entire metapneumonic interval was that during this time he lived on a barge, his father being a barge captain.

Physical Examination.—A boy, weighing 37 pounds (16.8 Kg.), whose height was 41½ inches (105 cm.), who looked robust, his face and body being tanned by exposure to the sun, in the erect position was bent toward the right. The head, eyes, ears, nose and mouth presented no abnormalities. The left side of the chest was normal, but the right showed a marked deformity and contraction. Associated with the latter was a moderate scoliosis and drooping of the right shoulder. Respiratory movements were limited on the affected side. There was the difference of 1 inch in the two sides of the chest. The heart was normal, not enlarged to the right, the apex in the fifth space in the nipple line. A systolic murmur heard at the apex was not transmitted. On percussion, the lungs gave definite flatness at the right base, over which area the breath sounds were absent and tactile fremitus was diminished. From the angle of the scapula on this side to the apex posteriorly, dulness with diminished breath sounds was elicited. Anteriorly, there

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* From the Department of Pediatrics, Cornell University Medical College, and the New York Nursery and Child's Hospital.

* Read before the Pediatric Section of the New York Academy of Medicine, May 13, 1926.

was moderate impairment of resonance, the breath sounds were high pitched, and accompanied by showers of fine râles. Over the left side of the chest the breath sounds were exaggerated, but no other deviations from the normal were found. The spleen was palpable two fingerbreadths below the costal margin; the liver edge was not palpable. The cervical and inguinal glands were palpable but small. There was slight clubbing of the fingers.

The roentgen-ray examination of the lungs at this time was interpreted as that of a thickened pleura secondary to an old pleurisy. A Pirquet test was negative, as was also the intradermal injection of 0.1 mg. of old tuberculin. A blood count showed a hemoglobin content of 70 per cent; white blood cells, 16,300, with 66 per cent polymorphonuclears, 30 per cent small lymphocytes, 3 per cent transitionals and 1 per cent basophils.

Despite the fact that practically a year had elapsed since the attack of pneumonia, an exploratory thoracopuncture was made, with the prompt withdrawal of thick pus, yielding hemolytic streptococcus on culture. The boy was transferred to

Fig. 1.—Effusion of right lung before operation.

the Lenox Hill Hospital on Nov. 12, 1925, to the surgical service of Dr. Franz Torek. Two days later, under ether anesthesia, an incision was made over the ninth rib in the posterior axillary line and 2 inches of rib was resected. A thick, well walled-off, almost rigid cavity was encountered, extending upward from the diaphragm, from which 3 ounces of thick green pus was evacuated. The visceral as well as the parietal pleura, was thick and resistant. Open drainage was instituted, together with the daily use of the James bottle. Except for an occasional elevation of temperature usually associated with a definite upper respiratory infection, the convalescent period was uneventful, and the boy was discharged on Feb. 18, 1926, with the chest wound entirely healed.

Six months after operation the deformity of the chest was much less marked, and reexpansion of the lung had taken place, as determined from physical signs and as corroborated by a roentgenogram. The boy gained 5 pounds (2.3 Kg.) in weight and 3½ inches (9 cm.) in height. His blood count showed a hemoglobin content of 89 per cent; red blood cells, 4,610,000; white blood cells, 10,700; polymorphonuclears, 64 per cent; large lymphocytes, 7 per cent, and small lymphocytes, 29 per cent.

COMMENT

Latent or undrained empyema, unrecognized for a year, as in this case, and even for longer periods was seen more commonly prior to the war. Holt [1] states that "the statistics of empyema before the general adoption of surgical treatment was appalling. Patients were either worn out by the protracted suppuration or died from amyloid degeneration, pneumonia or tuberculosis." He quotes Rilliet and Barthez, who found that in thirty-two cases without surgical treatment, there was a fatal outcome in twenty-one. In our case, the underlying condition was probably overlooked because of the healthy appearance of the boy, his ruddy complexion having been acquired by continuous outdoor exposure.

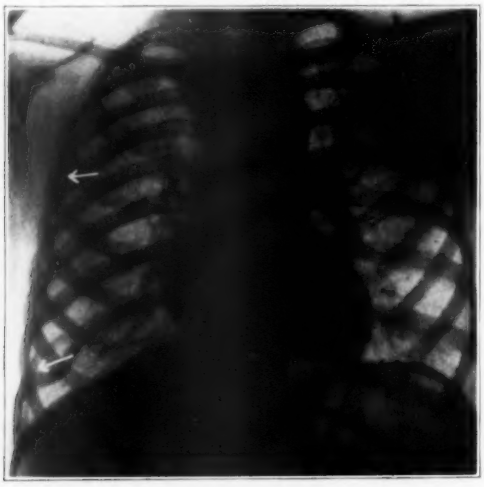

Fig. 2.—The same lung, six months after operation.

This factor was doubtless responsible for the absence of alarming symptoms although for a year the pleural cavity had harbored several ounces of streptococcic pus. It is interesting to note that with the liberation of pus this patient at once became more cheerful and took an active interest in everything about him.

The local physical changes in this case were as might be expected, namely, a markedly thickened pleura with retraction of the chest wall. Eventually the lung itself undergoes interstitial changes by reason of the pressure of the effusion on the pulmonary tissue.[2] At times, latent empyema is masked under the diagnosis of unresolved pneumonia.[3]

1. Holt, L. E.: The Diseases of Infancy and Childhood, ed. 7, 1920, p. 569.

2. Norris, G. W., and Landis, H. R. M.: Diseases of the Chest and the Principles of Physical Diagnosis, ed. 3, 1924, p. 506.

3. Pickhardt, O. C.: To be published.

Sequelae that follow in the train of long unrecognized empyema are rupture of the pus into a bronchus with recovery at times, as in the case described by Schloss,[4] perforation through the chest wall, the so-called empyema necessitatis,[5] or bronchiectasis. Rupture through the diaphragm six years after the original pneumonia is cited in a case of von Eberts'.[6] Eggers,[7] in a classification of chronic empyema, exemplifies the class of old, unrecognized empyema by a patient who, following an attack of influenza in September, 1918, had never been well. Twenty-three months after this illness he presented himself for surgical treatment, and in the first forty-eight hours 3,000 cc. of pneumococcic pus was withdrawn.

Wilensky,[8] reporting a series of 299 cases of empyema, mentions one patient in whom empyema lasted one year, and another in whom the condition lasted two years, before operation. Heuer,[9] in a series of 455 cases of the same condition, found ten patients with symptoms of empyema for from six to twelve months who had not been subjected to operative treatment. He points out the dangers of tardy recognition as prolonged convalescence after operation and the tendency toward increased chronicity. In 310 cases reported from the Mayo Clinic by Hedbloom,[10] there were fifteen of undrained or latent empyema which had existed for from six to twelve months, eight for from one to two years, and nine for from two to five years before eventual operation. The same author [11] states that in a series of 150 cases of chronic empyema at the same clinic, eleven occurred in children, yet five of the unrecognized cases were in this age group.

113 East Eighty-First Street.

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10. Hedbloom, C. A.: Causative Factors and Treatment of Chronic Empyema, J. A. M. A. **81**:991 (Sept. 22) 1923.

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CALCIUM METABOLISM STUDIES

A. THE RAISING OF SERUM CALCIUM BY TOPICAL APPLICATIONS OF RAW AND ACTIVATED COD LIVER OIL

B. DISTURBANCES ASSOCIATED WITH THE ACTIVE DENTAL CARIES OF CHILDHOOD AND PREGNANCY *

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CLEVELAND

That sunshine and cod liver oil will markedly affect calcium metabolism is altogether likely. The processes by which these effects are produced are but little understood. The studies presented here are part of a series being made to obtain data to throw light on the nature of the forces at work, and the mechanisms involved in the utilization of calcium by the body with special considerations of disturbances in calcium metabolism, particularly those which relate to tooth and bone formation, and degenerative changes in those structures after their development.

It has been demonstrated by many workers, especially by Alfred F. Hess,[1] Mildred Weinstock [2] and H. Steenbock,[3] that when animals are placed on a diet deficient in either phosphorus or calcium in the absence of sunlight, disturbances of the hard structures tend to appear, and that these may be prevented or corrected in large part by the addition of small amounts of cod liver oil to the diet, or the application of ultraviolet irradiation from artificial source to the surface of the animal.

Figure 1 shows typical progressive stages in the production of leg weakness in chickens, produced by placing them in restricted light on a diet low in phosphorus and low in fat soluble vitamins. This condition can be largely prevented by the administration of cod liver oil with the diet, also by the application of ultraviolet light from the quartz mercury vapor lamp. Figure 2 shows (*A*) a chick that was down practically as flat as the most extreme one shown in figure 1, and when cod liver oil was added to its food got up, as shown in *B*.

In order to demonstrate the nature of the action of cod liver oil and of ultraviolet light, chicks have been subjected to varying conditions. Table 1 shows in condensed form the result of placing twenty-five groups of chicks with six in each group, except the control group which con-

* Received for publication, July 31, 1926.

* Read before the National Academy of Sciences at Washington, D. C., April 27, 1926.

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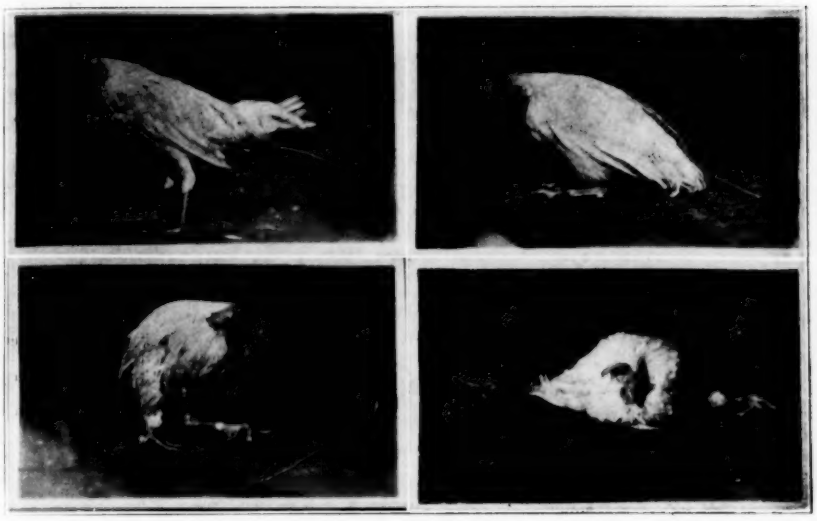


Fig. 1.—Progressive weakening of the legs of a chick deprived of radiant energy, and on a diet low in phosphorus and low in antirachitic factor. Control, upper left, had same diet but occasional sunshine.

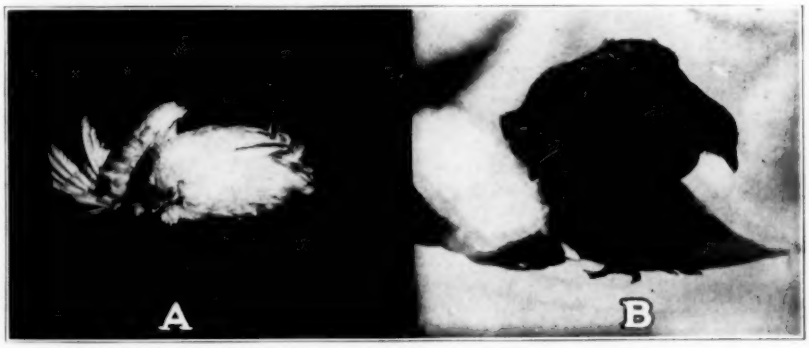


Fig. 2.—Two views of the same chick on a diet low in phosphorus and deprived of ultraviolet irradiation. *A*, completely prostrated with typical weak legs. *B*, same chick a few weeks later, after cod liver oil was added to the food. The leg deformity should be noted.

tained fifteen, namely, nine in lot 1, and 6 in lot 25. The first control lot had as much sunshine as could be given during the day, and the last had three hours daily. All of these chicks were on the same basic diet (McCollum's, 3143), the variation being entirely in activation or light source. All except the two control groups were kept in darkness except for the turning on of ruby light twice daily for two hours for feeding.

TABLE 1.—*Comparative Studies of Different Methods for Modifying Treatment of Chicks on Low Phosphorus Diet* *

Lot No.	Variable Condition	Deaths During Days of Experiment 2	3	4	5	6	7	8	9	10	11	12	13	14	Number Dead	Number Living	Condition
1	Controls														0	9	Active; well feathered
2	Darkness and ruby lamp			1	2		1		1	1					6	0	All dead; weak legs
3	Same as 2 plus ultraviolet daily for 30 minutes		1				2								3	3	Active; well feathered
4	Same as 3 plus blue filter		2						1						3	3	Active; well feathered
5	Same as 3 plus heavy window glass				3	2	1								6	0	All dead; weak legs
6	Same as 2 plus cod liver oil 1 per cent				2	1		1							4	2	Retarded growth
7	Same as 6 but 0.1 per cent	1		1	2		1		1						6	0	All dead; weak legs
8	Activated cod liver oil sunshine, 0.1 per cent	1			2							1			4	2	Medium growth
9	Same as 8 but 1 per cent		2			2								1	5	1	Medium growth
10	Cod liver oil activated 15 minutes, 0.1 per cent			1	1	2									4	2	Medium growth
11	Same as 10 but 1 per cent	1				1	1								3	3	Active; medium growth
12	Cod liver oil activated 6 hours sunshine, 0.1 per cent					1		1							2	4	Active; well feathered
13	Same as 12 but 1 per cent							1							1	5	Active; well feathered
14	Same as 12 but 5 per cent	1	2		2							1			6	0	All dead
15	Cod liver oil activated, ultraviolet 3 hours, 0.1 per cent	1	2			1									4	2	Retarded growth
16	Same as 15 but 1 per cent		1	1		2	1								5	1	Retarded growth
17	Same as 15 but 5 per cent						1								1	5	Active; well feathered
18	Raw cod liver oil 5 per cent		1	3	1										5	1	Well feathered; medium activity
19	Cod liver oil activated, sunshine 30 minutes, rubbed on neck					1	2								3	3	Active; delayed feathers
20	Same as 19; raw cod liver oil				1	2								1	4	2	Delayed growth; poor activity
21	Cholesterol activated ultraviolet, 1 per cent					1					1		1		3	3	Medium feathered; active
22	Same as 21 not activated, 1 per cent			1		4		1							6	0	All dead
23	1 per cent parathyroid extract			1											1	5	Medium feathered; fair activity
24	Food exposed to ultraviolet daily	2	1	1											4	2	Delayed growth
25	Exposed 3 hours daily to sunshine														0	6	Active; well feathered

* Nature and effect of activators. Six chicks in each group. All had same adequate diet and temperature.

OUTLINE OF PLAN

Group 1, control sunshine. All lived.

Group 2, darkness and ruby light, plus the basic diet. All of these died.

Group 3, the same, plus ultraviolet rays, for thirty minutes daily; three are living and three are dead. Those alive are active and well feathered.

Group 4, the same as 3, plus blue filter. Three are dead, and three living, active and well feathered.

Group 5, the same as 3, namely, ultraviolet rays for thirty minutes daily, plus heavy window glass. All died. They had weak legs.

Group 6, the same as 2, plus 1 per cent cod liver oil. Four are dead, two are living, but their growth was retarded.

Group 7, the same as 6, with 0.1 of 1 per cent of cod liver oil. All died.

Group 8, 0.1 of 1 per cent of cod liver oil activated in sunshine. Four are dead, two living, with medium growth.

Group 9, the same as 8, but with 1 per cent of activated cod liver oil. Five are dead, one is living, with medium growth.

Group 10, 0.1 of 1 per cent cod liver oil activated for fifteen minutes with ultraviolet rays. Three are dead and three living, with active and medium growth.

Group 11, the same as 10, but with 1 per cent activated cod liver oil. Three are dead and three living, with active and medium growth.

Group 12, 0.1 of 1 per cent cod liver oil activated six hours in sunshine. Two are dead; four living are active and well feathered.

Group 13, same as 12, but with 1 per cent cod liver oil. One died; five living are active and well feathered.

Group 14, same as 12, but with 5 per cent of cod liver oil. All are dead.

Group 15, 0.1 of 1 per cent cod liver oil, activated for three hours. Four are dead; two living, with retarded growth.

Group 16, the same as 15, but with 1 per cent of cod liver oil. Five are dead; one is living, with retarded growth.

Group 17, the same as 15, but with 5 per cent cod liver oil. One is dead; five are living, and are active and well feathered.

Group 18, 5 per cent of raw cod liver oil. Five are dead; one is living, well feathered and with medium activity.

Group 19, cod liver oil, activated in sunshine for thirty minutes, rubbed on the neck. Three are dead; three living, are active, with delayed growth of feathers.

Group 20, raw cod liver oil rubbed on neck. Four are dead; two are living, with delayed growth and poor activity.

Group 21, cholesterol activated with ultraviolet ray, 1 per cent in food. Three are dead; three living are medium feathered and active.

Group 22, 1 per cent nonactivated cod liver oil added to food. All died.

Group 23, 1 per cent parathyroid extract. One is dead; five are living, medium feathered and fairly active.

Group 24, the food was exposed to ultraviolet rays daily. Four are dead; two living, with delayed growth.

Group 25, sunshine three hours daily. All lived.

It will be noted from these data that with nonactivated cholesterol added to the food, all chickens died; with the activated cholesterol, three lived. Further, that with 5 per cent of cod liver oil, activated in the sunshine for six hours, added to the food, all died; further, that by placing of heavy window glass in front of the ultraviolet to obstruct the rays, all chicks died. It should further be noted that cod liver oil, activated thirty minutes in the sunshine, rubbed on the necks of the chicks, saved three out of six and raw cod liver oil used the same way saved two out of six. One per cent of freshly made extract of parathyroid added to the food saved five out of six.

In order to study further the nature of these processes, chemical analyses were made of the blood to determine changes in certain of the calcium factors. This is shown in table 2. For these Steenbock

and Nelson's diet 2966 was used. In this series, 216 chicks were used. I will here call attention particularly to the following:

TABLE 2.—*Blood and Lymph Chemical Studies of Chicks by Groups*

Chicks	Diet 2966	Gain, per Cent	Calcium		Inorganic Phosphorus	Total Calcium × Inorganic Phosphorus
			Total of Serum	Active		
1	Controls, sunshine	63.8	9.96	8.14	4.52	45.00
2	Ruby light	154.7	10.28	8.30	4.83	49.65
3	Ultraviolet ray, 20 minutes daily	111.6	9.25	8.30	4.10	37.92
4	Ultraviolet ray, 2 hours daily	95.7	8.53	8.13	4.10	34.97
5	1% raw cod liver oil	176.6	9.73	6.60	6.33	61.59
6	5% raw cod liver oil	57.7	8.95	8.33	5.26	47.19
7	10% raw cod liver oil	74.3	9.45	8.13	2.90	27.40
8	1% cod liver oil, 15 minutes sunshine	69.2	10.90	8.82	3.17	34.55
9	5% cod liver oil, 15 minutes sunshine	78.03	13.13	10.02	2.93	38.48
10	10% cod liver oil, 15 minutes sunshine	55.05	10.07	10.22	2.10	22.48
11	1% cod liver oil, 1 hour sunshine	85.2	20.21	.....	2.22	46.82
12	5% cod liver oil, 1 hour sunshine	77.3	9.66	7.64	3.90	37.67
13	10% cod liver oil, 1 hour sunshine	70.6	11.48	8.32	2.77	31.62
14	1% cod liver oil, 24 hours sunshine	72.9	11.37	8.66	3.71	42.18
15	5% cod liver oil, 24 hours sunshine	76.6	10.25	8.52	3.62	37.20
16	10% cod liver oil, 24 hours sunshine	67.2	9.72	8.82	3.51	34.10
17	1% cod liver oil, 24 hours ultraviolet	133.1	10.84	5.84	5.45	59.07
18	5% cod liver oil, 24 hours ultraviolet	89.04	10.96	6.60	4.85	53.16
19	10% cod liver oil, 24 hours ultraviolet	36.8	10.42	8.32	1.94	20.20
20	Raw cod liver oil on necks	6.3	11.26	.....	....	.....
20	Fluid from necks of 20	....	18.97	14.19	....	.....
21	Cod liver oil 30 minutes on necks	56.07	15.04	10.22	2.15	32.35
21	Fluid from neck of 21	....	27.14	18.09	....	.....
22	5% raw cholesterol	1.4	9.35	8.92	2.24	20.91
23	5% cholesterol, 30 minutes sunshine	26.1	10.25	....	4.77	48.90
24	10% raw butter	62.2	11.69	7.25	5.40	63.13
25	10% butter, 24 hours ultraviolet	50.8	8.95	6.75	5.20	46.54

CHEMICAL ANALYSIS

The average total calcium of the controls was 9.9, the active 8.1, and the inorganic phosphorus 4.5. Of the chicks under treatment, several have had distinctly higher total calcium than the controls. For example, those receiving 5 per cent cod liver oil activated in the sun for fifteen minutes had a total calcium of 13.1. One of the methods of investigation of the influence of cod liver oil was to rub it on a limited portion of the chicken's body, as, for example, the neck. This had a very marked effect on the level of the calcium of the blood and on the general physical condition of the chicks. The average total calcium of the blood of this group was 11.2, whereas the average total calcium of the controls was 9.9. The chicks of another group were treated similarly with the cod liver oil on the neck, except that it had been activated in the sun for thirty minutes. The average total calcium of the blood of the chicks of this group was 15.

The inorganic phosphorus was also influenced by the various methods of the utilization of cod liver oil. The average in the control groups was 4.5, and of the group receiving 5 per cent raw cod liver oil in the food the average was 5.2. The group receiving activated cod liver oil on the necks had an inorganic phosphorus of 2.1.

Similar studies were made by making topical applications of cholesterol. The average total calcium of the group receiving applications of 5 per cent nonactivated cholesterol was 9.3, whereas another group receiving the same method of treatment and material, except that it was activated in the sun for thirty minutes, had an average total calcium of 10.2.

Several of the chicks that were having cod liver oil rubbed on their necks in each of the different groups developed large cystic sacs filled with serous fluid. This fluid was aspirated, pooled together for each group, and calcium determinations were made. As the circulating lymph, spinal, pleuritic and ascitic fluids have total calcium levels from 40 to 60 per cent of that of the total calcium of the blood, and since the total calcium of these serums has corresponded approximately in amount with the diffusible calcium of the blood, it has been suggested that the differences in level of calcium in these serums and the blood are controlled by the diffusion through the tissues, the colloidal calcium being held back by the tissues. I have already stated that the total calcium of the blood of these serums was higher than that of the control, namely, 11.2 and 15, while the control was 9.9. If now one would anticipate the same general relationships between blood calcium and cystic fluid, as in ascites and lymph, he would have factors approximately half of 11 and 15. Contrary to expectations, the average total calcium of the fluid from the neck of the group receiving raw cod liver oil applied topically was 18.9, instead of 5 or 6, and for the group having the activated cod liver oil applied locally the average was 27, instead of 7 or 8. In other words, in the second group the total calcium level of the fluid in the neck was nearly twice that of the total calcium of the blood, instead of half.

MECHANISM OF ACTIVATION

This seems to throw an important new light on the mechanism of activation. Had a calcium salt been applied with cod liver oil, raw or activated, one might think that the calcium was absorbed by the tissue being treated. Since, however, in this case, the calcium of the aspirated fluid was higher than that of the blood stream, and since no calcium could reach this fluid except through the blood stream, there must have been established in the chicks a condition of increased solubility for calcium in this fluid, which in turn influenced the blood to bring the total blood calcium higher than that of the controls. This also indicates that this fluid had a solubility factor higher than that of the blood to take calcium from the blood to it.

From the foregoing, it will be noted that exposing the cod liver oil and cholesterol to radiant energy, sunshine or ultraviolet rays, changes in a marked degree the effect produced by the use of the oil or cholesterol.

and, further, that overexposure produced deleterious effects. Evidence has been presented to the effect that butter exposed to ultraviolet irradiation for several hours was made distinctly poisonous for mice, though this observation would indicate that it was not poisonous for chicks.

In order to study further the effect of ultraviolet irradiation, cod liver oil, so exposed, has been further studied as follows: When ordinary raw cod liver oil is placed in a dish, and a photographic plate is placed over the dish, the chemical action produces fogging of the emulsion, which is decreased by decreasing temperature, and increased by increasing temperature, as shown in figure 3. *A* was placed in the icebox, but *B* in the incubator for an equal period of time. *A* had an obstruction made of tissue paper in varying thicknesses, progressing

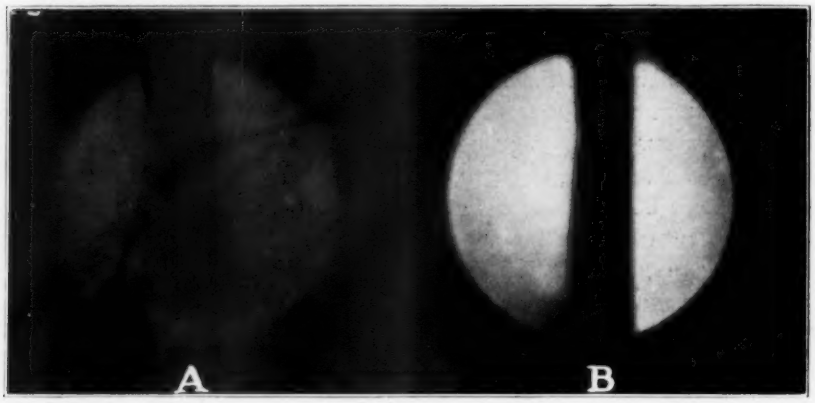


Fig. 3.—Clouding of a photographic plate produced by cod liver oil from hydrogen dioxide formation.

from 1 to 20 layers. These twenty layers obstructed completely the gaseous substance which produced the chemical action. In *B* the obstruction was a piece of card. This photographic effect is not produced by radiant energy given off by the oil, but by gases, the chief of which is hydrogen dioxide. When cod liver oil is exposed to ultraviolet light or sunshine, this capacity for clouding a photographic plate is very markedly increased, as shown in figure 4. Two different brands (*A* and *B*) of cod liver oil were used, and the figures 1 to 8 show progressively the exposures for the following units of time:

1. Not exposed to ultraviolet ray.
2. Exposed to ultraviolet ray for five minutes.
3. Exposed to ultraviolet ray for ten minutes.
4. Exposed to ultraviolet ray for fifteen minutes.
5. Exposed to ultraviolet ray for twenty minutes.
6. Exposed to ultraviolet ray for thirty minutes.
7. Exposed to ultraviolet ray for forty minutes.
8. Exposed to ultraviolet ray for sixty minutes.

In a subsequent communication will be reported studies made of a large number of organic compounds, chiefly tissue extracts, only one of which is included here. In figure 5 is shown the effect of exposing an extract of pancreas in "B" to ultraviolet rays form a mercury vapor lamp for thirty minutes, and in "C" to sunshine for one hour, in comparison with the same shown in "A" without exposure. It is important to note the marked difference in effect of the ultraviolet rays from the quartz

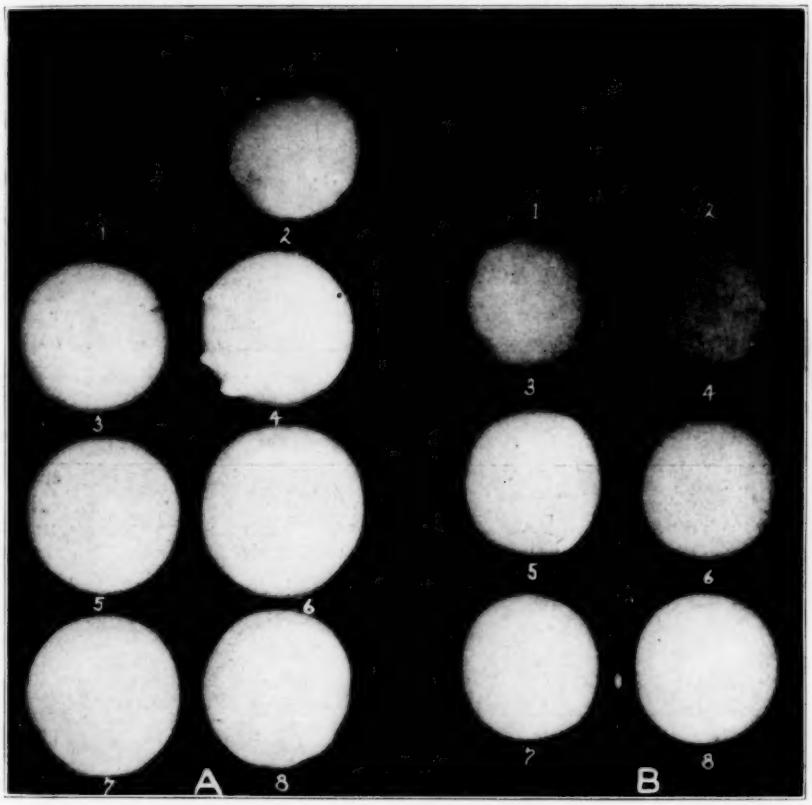


Fig. 4.—Progressive increase in capacity of cod liver oil to cloud a photographic plate, with increase of time of exposure of oil to sunshine or ultraviolet irradiation.

vapor lamp and that of sunshine. The administration of calcium lactate with cod liver oil produces entirely different effects, both clinically and as expressed in chemical constituents of the blood from the administration of either of these substances alone.

I have made observations to determine the effect on the ability of cod liver oil to cloud a photographic plate, with and without the addition of calcium lactate. In figure 6 three views are shown: *A*, cod liver oil

alone with its brilliant reaction; *B*, 90 per cent cod liver oil, and 10 per cent calcium lactate, and *C* shows 50 per cent cod liver oil, and 50 per cent calcium lactate. It will be observed that in the last proportion, the capacity of the cod liver oil to produce clouding has been completely destroyed, and indeed on close observation of the negative one can see a distinctly opposite affect, which on first consideration might be thought to be a true reversal, but which on testing is not the reversal of overexposure.

Fig. 5.—The marked difference in effect on a photographic plate, with exposure to sunlight in mercury vapor lamp.

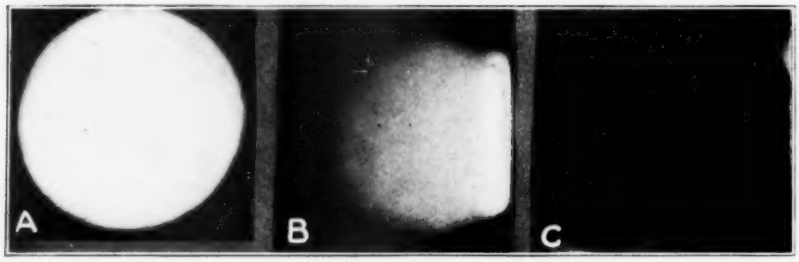
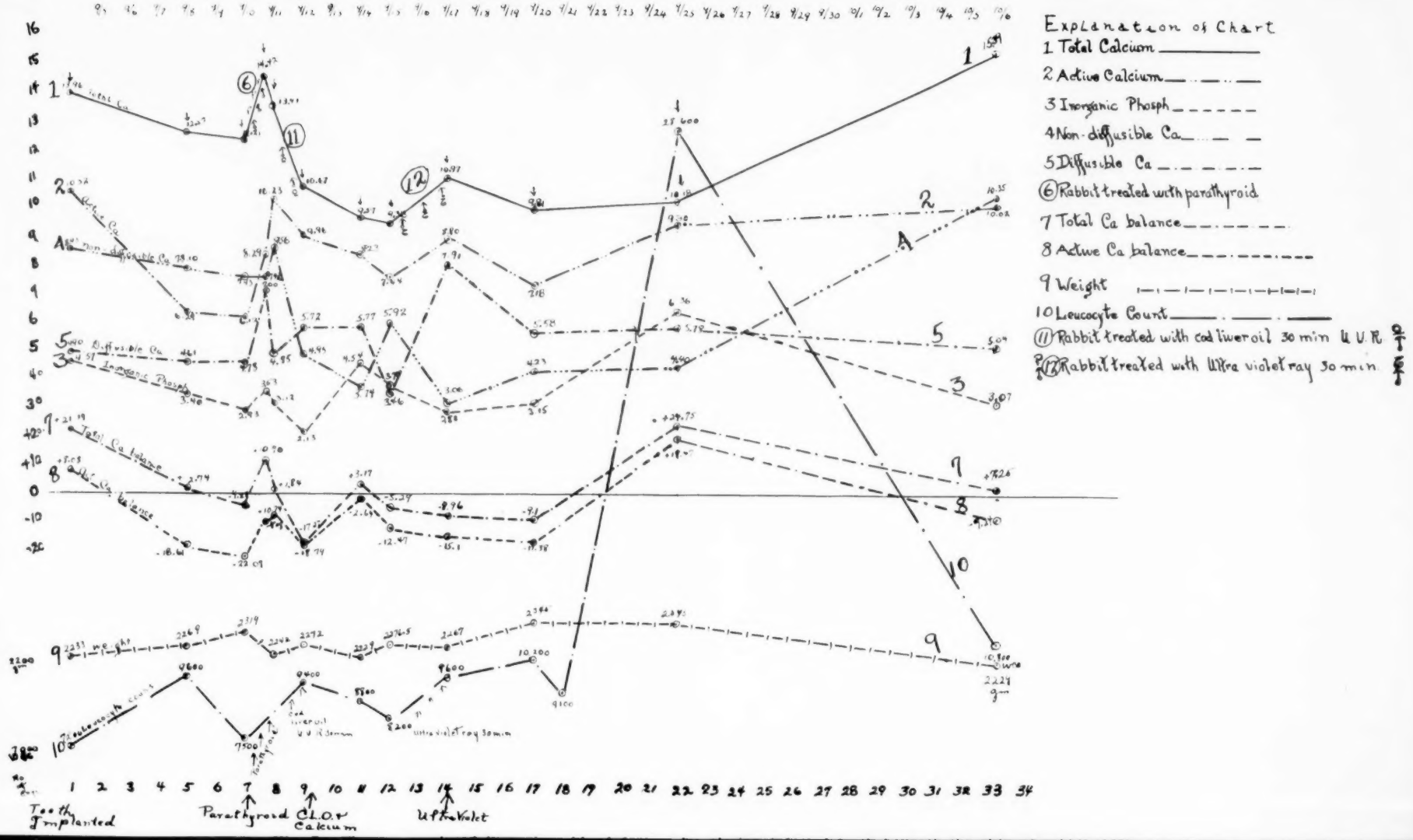


Fig. 6.—The change in effect of cod liver oil on the addition of calcium lactate.

A typical result of applying these processes in an experimental case. is shown in the following experiment:

Since the various forces operating to maintain normal balance are in equilibrium in health, the effects of treatment in changing relative levels will be essentially different in normal and in pathologic states. In the latter state, depletion or exhaustion may become determining factors, unless reinforcement is provided. This the physician has undertaken to do by producing a pathologic state, then undertaking to modify the developing abnormalities through the means of treatment. Some idea of these general effects can be obtained from a review of the progressive changes produced by placing an infected tooth beneath the skin, as shown in figure 7, which

shows a graph of the consolidated story of the inoculation of rabbit 1356 by putting an infected tooth beneath its skin, at which time the total calcium (1) stood at 13.9 mg.; the active calcium (2) at 10.5 mg.; non-diffusible (4) at 8.4 mg.; diffusible (5) at 4.9 mg.; inorganic phosphorus (3) at 4.5 mg.; total calcium balance (7) at plus 21 mg. (the product of inorganic phosphorus and total calcium, minus 40); the active calcium balance (8) at plus 8 mg. (the product of active calcium and inorganic phosphorus, minus 40). The horizontal line on the chart represents 40, and the figures above and below this line represent positive or negative calcium balance. The weight line, 2,200 Gm., which is represented by increase or decrease above or below the starting point, is shown in (9) and the leukocytic count, starting at 7,000 in the graph (10). The heavier penpendicular lines of the squares represent the number of days, and the heavier horizontal lines milligrams per hundred. It will be noted that in the first five days, after the infected tooth was placed under the skin of the animal, the total calcium decreased from 13.9 to 12.5, during which time the active calcium decreased from 10.5 to 6.2; the inorganic phosphorus decreased from 4.5 to 3.4, and the calcium balance for both total and active accordingly dropped rapidly. All animals and all subjects whose calcium balance lines are below the base line are presumably in a pathologic state. In more than 200 rabbits studied by placing an infected tooth beneath the skin, 75 per cent have died, as I have stated when the active calcium decreased to the vicinity of 5 mg. This rabbit, at the end of seven days, was therefore in grave danger. The active calcium balance stood at minus 22. According to the history of previous cases, the animal would soon have been dead. At this point, an injection of parathyroid extract was made, at which time the leukocytic count, which had gone up during the first four days, was receding. It will be noted that with the three injections of our own preparation of parathyroid by the method of Collip, which increased the solubility factor of the blood for calcium, all of the graphs rapidly moved upward, the total going from 12.2 to 14.4, the active from 6.1 to 8.2; the calcium balances both changed. The leukocytic count improved, but this improvement was temporary, and the rabbit soon began to decline. With this temporary improvement, at which time calcium was being taken from the bones through the increase in the solubility factor of the blood for calcium, there was a marked loss in weight of the animal, coincident with the improvement in the clinical picture. The fuel for the defense was secured at the expense of the body tissues. At this point, to check the further decline, and in order to pay the calcium bill from without, activated cod liver oil and calcium lactate, on two days in succession, were placed in the rabbit's stomach by tube, as shown at the point of the arrow on the ninth day. Again there was a marked improvement in the calcium balance, largely through the reenforcement of the metabolism of inorganic phosphorus.


Explanation of Chart
1 Total Calcium
2 Active Calcium
3 Inorganic Phosph
4 Non-diffusible Ca
5 Diffusible Ca
6 Rabbit treated with parathyroid
7 Total Ca balance
8 Active Ca balance
9 Weight
10 Leucocyte Count
11 Rabbit treated with cod liver oil 30 min U.V.R.
12 Rabbit treated with Ultra violet ray 30 min
Tooth Implanted
Parathyroid
C.L.O. Calcium
U.V.R.

This improvement was again temporary. It should be noted that the total calcium came down progressively (at the figure marked 11) following the administration of parathyroid, but with the administration of the activated cod liver oil and calcium lactate, the active calcium came up rapidly to 10.2, approximately its starting point. The rabbit was still carrying the infection, and a quantity of pus, making an abscess about as large as a hen's egg, had accumulated around the tooth. Ultraviolet irradiation, thirty minutes daily, was given on three successive days, at the time marked (12) on the total calcium line. One should note the increase shortly after this in the leukocytic count, which jumped from 9,000 to 28,000. With this splendid defensive reaction, the size of the accumulation around the tooth decreased from the size of a hen's egg to about the size of a hickory nut, so that the pus was no longer palpable. It should be noted that the calcium balance for both total and active calcium passed well above the zero line; the total calcium again mounted to and above its original normal, 15.3; the tissue over the tooth broke down, the tooth was exfoliated and the animal was out of danger. At the time of this writing, six months after the foregoing experiment, the animal is apparently still in good health. Space does not permit the inclusion in the graph of extensions of the lines to the time of the exfoliation of the tooth.

The negative calcium balance produced in this experiment by the placing of an infected tooth beneath the skin of the animal resulted from exhaustion of the easily available calcium supply of the circulation, and the depression of function of the factors involved in maintaining the defensive warfare. In other words, a pathologic state has been produced which creates an abnormal stress on the mechanisms of immunity and defense, a part of which involves the calcium and phosphorus metabolism.

In previous communications,[4] I have presented data which related calcium metabolism disturbances both to focal infections and to various degenerative diseases. These data throw light on some of the mechanisms involved in these processes.

PHYSICAL DISTURBANCES AND DENTAL CARIES

Physiologic stresses may produce very unusual demands on the same factors. This is well illustrated in the conditions of the stress of growing childhood and of motherhood. It is a matter of universal knowledge that both childhood and maternity constitute periods of an unusual susceptibility to dental caries. The old saying, "A tooth for every child" is familiar to all. The period of lactation is known to be quite as susceptible a period as that of pregnancy. Oral hygiene and prophy-

4. Price, Weston A.: Dental Infections, Oral and Systemic, Cleveland, Penton Publishing Company; Dental Infections and the Degenerative Diseases, Cleveland, Penton Publishing Company; Ann. Clin. Med. **4**:943 (May) 1926.

laxis have tended to reduce dental caries in both these groups. They have not, however, proved adequate to prevent dental caries in conditions of marked susceptibility.

These studies have involved investigations along many lines to throw light on the mechanisms whereby calcium is taken from the food and made available to the body for growth and nutrition, and the forces which disturb their normal progress.

During growth, there is an abnormal demand for calcium for tooth and skeleton building. During pregnancy and lactation, there is an increased demand on the mother for the fetus and for the growing infant. When the nutrition cannot supply ample calcium for the immediate demands, the mother takes the essential constituents from her own system to meet the needs. The laws of supply and demand operate in favor of the fetus in preference to the mother. In case of a deficient supply, the mother is in negative calcium balance, that is, she is using calcium faster than she is assimilating it, with the result that the storage depots in the calcified structures are being depleted.

Since the body is not able to utilize calcium, except through the aid of certain accessory food factors and radiant energy factors, the expectant mother may be in marked negative calcium balance on a diet actually containing adequate calcium, but unavailable for her use. These studies indicate that in the rapid caries of childhood and in pregnancy and lactation, there is a state of marked negative calcium balance, and that this condition is an important contributing factor to the process in conjunction with bacterial processes.

The administration of calcium lactate and cod liver oil, raw or activated, to the growing child at the period of active caries, and to the expectant mother as well as during her period of lactation, not only benefits their well-being, but in a very marked degree reduces the tendency to dental caries. Their change in susceptibility to caries is directly associated with their change from a negative to a positive calcium balance.

The average number of cavities per pregnancy has been estimated as five, with an average of one tooth completely lost. These factors will vary greatly in different communities. Under the treatment mentioned in the foregoing, in my experience, this has been reduced to an average of approximately one cavity per pregnancy. In the rapid caries of childhood, mouths that would have a dozen or more new cavities per year, have had the same very greatly reduced, in some nearly to zero. Delayed development of permanent teeth in childhood, associated with delayed shedding of deciduous teeth, and the eruption of permanent teeth, has changed to a condition in which exfoliation, root-formation and eruption have been greatly hastened under this treatment. In some cases there has been as much progress in a few months after starting treatment as in the few years preceding it.

A practical application is shown in the following case. Figure 8 or 10 years of age. The roots of the permanent teeth were not forming during which time the deciduous teeth had not been normally exfoliated or the permanent teeth erupted, which should have taken place at 9 or 10 years of age. The roots of the permanent teeth were not forming properly, nor were the bones surrounding them of normal radiopacity. In one month's time, after placing this boy on the treatment of activated cod liver oil and calcium lactate, the deciduous teeth were shed, and in three months' time the permanent teeth showed marked advance in their calcification and eruption. During this period of three months the boy grew 1 inch in height. Table 3 shows his changed physical state in two months' time, during which he grew $^{11}/_{16}$ of an inch, gained 4 pounds in weight, and physically was markedly better. Sufficient improvement in calcium and phosphorus levels was produced in these two months to change his negative calcium balance of minus 16 to a positive calcium balance of plus 33 (*C*).

Fig. 8.—Comparison of progress of calcification between the first two pictures (*A* and *B*), three years and eleven months apart, and between the last two pictures, three months apart (*C*). The retained deciduous teeth were shed in one month after starting treatment.

TABLE 3.—*Change Produced in a Boy with Delayed Dentition by Sixty Days' Treatment to Improve Calcium Metabolism*

	Conditions or Symptoms		
	Before Treatment	Time Elapsed	After Treatment
Total weight	70 pounds	2 mo.	4 pounds gain; 74 pounds
Height	4 ft. 5½ in.		4 ft. $6^{3}/_{16}$ in. (gain $^{11}/_{16}$ in.)
Physical state	Poorly nourished		Looks better nourished
Nervous state	Listless; irritable		Very anxious to go to school
Digestive condition	Poor appetite; shunning fruits and vegetables		Good appetite; now likes vegetables
Serum calcium	9.06		9.56
Inorganic phosphorus	2.65		7.71
Calcium balance	—16 (negative)		+33.7 (positive)

A disturbance of the mechanisms of calcification occurs very frequently in children of delayed development. This has its physical expression in lack of density of the bone around the teeth, and in delayed development of the tooth structure, particularly a delay in the reduction of the size of the pulp chambers of permanent teeth. This condition frequently happens in children with marked susceptibility to dental caries.

Such a case is shown in figure 9. This boy, at 14 years of age had a large number of cavities, some of which nearly entered the pulp chambers, partly because the pulps were abnormally large. He was placed on calcium lactate and activated cod liver oil. In the upper illustration it will be seen that the pulp chamber is abnormally large, and in the lower one, taken a year later, the same condition is shown, showing that the pulp chamber has reduced approximately to normal size for that age. During this period of a year, only one very small new cavity has developed, which is a most important improvement. Physically, he has changed from a nervous, irritable, easily frightened child, in which state

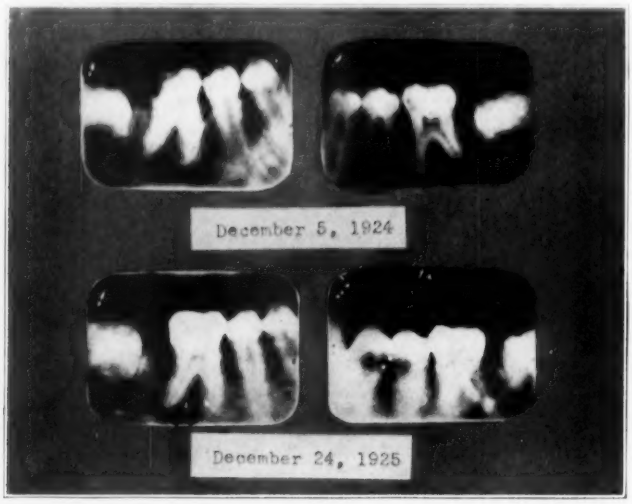


Fig. 9.—Change in calcification of permanent teeth in one year's time by treatment to improve calcium metabolism. Previous active caries completely checked.

it was almost impossible at first to render professional service, to a condition of marked lessening of this abnormal state.

An illustration of the change in the condition of expectant motherhood is shown in table 4. The change in physical state is shown by comparison in the two columns. The negative calcium balance was reduced almost to zero. The abnormal demand was now supplied from external sources and the stress of maintaining body equilibrium was thereby reduced. The patient's physical state was so greatly improved that she was able to perform her duties practically all day, whereas with her first pregnancy she was dragging, and almost bedridden through the entire period.

Another and striking illustration of improvement following treatment in the calcium factors in a case of pregnancy is shown in table 5. It will be seen that in twenty-five days the calcium balance changed from a negative one of minus 28 to minus 7. The diffusible calcium, which was at 3.8, increased to 5.2. The total serum calcium per hundred cubic centimeters of serum (not of blood) increased from 9.1 to 12.2, an increase of 33.1 per cent. With these changes there was marked improvement in the patient's general physical condition. An important

TABLE 4.—*Change in a Case of Pregnancy After Six Weeks' Treatment to Improve Calcium Metabolism*

	Conditions or Symptoms		
	Before Treatment*	Time Elapsed	After Treatment
Disturbance	Many boils	6 weeks	Complete absence
Physical state	Fatigue		Exhilaration
Nervous state	Depression		Animation
Digestive condition	Poor appetite and nausea		Excellent appetite; no nausea
Serum calcium	10.06	24 days	10.28
Inorganic phosphorus	3.32		3.87
Total proteins	5.91		7.12
Total globulin	2.41		4.02
Calcium balance	−6.7		−0.3

Second pregnancy. Aged 30.
* Treatment began third month.

TABLE 5.—*Calcium Stress of Pregnancy*

	Before	After	May 28, 1926	June 22, 1926
Calcium per 100 cc. of whole blood			7.39	9.29
Calcium of serum of 100 cc. of whole blood	6.89	8.28		
Calcium of cells and clot of 100 cc. of whole blood	0.50	1.01		
	7.39	9.29		
Calcium of 100 cc. of serum			9.12	12.22
Calcium of 100 cc. of cells and clot			1.99	3.16
Cellular calcium per cent of total			6.71	8.29
Calcium of 100 cc. of plasma (citrated)			8.00	10.42
Diffusible calcium			3.89	5.20
Nondiffusible calcium (colloidal)			5.25	7.02
Cell volume			25.40	22.50
Inorganic phosphorus			1.25	2.63
Sugar			91.80	.....
Nonprotein nitrogen			23.00	.....
Total calcium balance (negative)			−28.60	−7.8

Second pregnancy, eighth month. First lost at seventh month.

factor in her condition was the tendency to anemia. The red blood count was 3,800,000; Arneth index 51, and white blood cell count 13,800. There was marked central pallor in the red cells, but no anisocytosis or poikilocytosis, and in both cases normoblasts were seen.

In another paper I will discuss data which relate to the distribution of the calcium in the blood plasma and cells in anemia. This patient has completed her term, has had a normal birth, and both she and the child are in excellent condition.

COMMENT

The evidence strongly indicates that the marked susceptibility to dental caries of both childhood and motherhood is, in part, due to a state of stress, in which the subjects are in a condition of negative calcium balance, and that a correction of this phase can often be improved generally by the administration of small quantities of activated cod liver oil, together with calcium lactate. The cod liver oil is given in capsules 0 or 00. In the 00 capsules 10 drops of the activated oil are placed with a dropper, and sufficient is made up to last two weeks. The oil becomes rancid much more quickly after being activated. It should be kept on ice in the meantime. The oil is given simultaneously with the calcium lactate, 1 to 10 grains, according to the overload. These are taken together during the meal, with 3 meals a day in accordance with the conditions. In a few cases, 2 capsules and 20 grains will be taken to advantage with each meal. Usually this will be too large a dose. Increasing the cod liver oil over this amount is a distinct disadvantage, as is also increasing of the calcium lactate over this amount in most cases.

Cod liver oil is activated by placing it in an open dinner plate, in a layer not over one eighth of an inch deep, and exposed to the bright noonday sunshine for from three to five minutes in the summer, and from five to fifteen minutes in the winter. It should be stirred while being exposed. Exposure for longer periods, say an hour or two, will produce a change in the oil so that very undesirable symptoms such as headache may develop. When, for example, butter is exposed to the ultraviolet light for several hours, it is so poisonous as to produce the death of mice, and, as I have indicated before, all of the chicks died after being fed on cod liver oil that had been exposed to six hours' sunshine. In our experience, cod liver oil should not be activated with ultraviolet light from the mercury vapor lamp, since it produces changes in the oil which are distinctly harmful.

I am reporting here only a limited phase of the studies on this problem. Intensive studies also are being made on the relation of focal infection, particularly dental infection, to calcium metabolism disturbances, and with particular consideration of the correction of these disturbances, or betterment of pathologic conditions thereby created, both by the removal of the focal infections, and by treatment with a view to reinforcing disturbed calcium and phosphorus metabolism. Among these disturbances are the anemias and various degenerative diseases of special tissues.

SUMMARY

1. Data have been presented indicating that certain calcium factors of the blood are influenced by activators which may be applied either through the normal route by the stomach, or externally to the surface

of the body. In the former, they may be related directly to the utilization of the calcium from the food. When applied externally, however, they must act on the food by first acting on the circulating fluids of the body.

2. A specific action of the activators on fluids of the body for the increasing of their capacity to carry calcium is shown by the raising of calcium in tissue fluid to a concentration which is higher than the concentration of the blood from which it must be obtained directly or indirectly, notwithstanding the fact that the level of calcium tissue fluid is normally of approximately one-half that of the total calcium of the plasma.

3. Data are presented indicating that the dental caries of both childhood and pregnancy are influenced directly by the administration of activators for calcium metabolism.

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POSTOPERATIVE LEUKOCYTOSIS AND TEMPERATURE VARIATIONS FOLLOWING TONSILLECTOMY *

AN ANALYSIS OF 147 CASES ARRANGED IN FOUR AGE GROUPS

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Postoperative leukocytosis was first described by George Schultz,[1] in an article published in 1893. A number of confirmatory studies followed his publication of the fact that surgical operations on noninfected patients were followed by an increase in the blood leukocytes.

The more recent studies in this field include the work of Busse [2] who, in 1905, studied patients after extraperitoneal gynecologic operations, and concluded that the leukocytosis was a normal sequel of such operations. He found that the increase in the leukocytes lasted for several days, and that their fall after this rise could easily be plotted to a practically standard graph.

Krumbhaar,[3] in 1917, studied postoperative leukocytosis in the dog, and found that a considerable rise in the leukocytes followed all cutting operations, and occurred in a less degree after narcosis and hemorrhage. His studies led him to conclude that in this form of leukocytosis the new and younger forms of polymorphonuclear leukocytes were drawn from the bone marrow into the peripheral circulation.

Stahl,[4] in 1921, dealing with intraperitoneal operations on the dog, concluded that parenteral absorption of protein is the causative agency, and could not exclude the possible influence of a slight degree of infection through the operative wound.

In 1925, Witter,[5] studied thirty noninfected gynecologic patients after operation and concluded that the postoperative rise in leukocytes reached its height on the fourth hour after operation, and returned to normal by the fifth day. She believed the height of the peak to be influenced by

* Received for publication, Aug. 7, 1926.
* From the Children's Hospital.

1. Schultz, George: Experimentelle Untersuchungen uber das Vorkommen und die diagnostische Bedeutung der Leukocytose, Deutsches Arch. f. klin. Med. **51**:234-281, 1893.

2. Busse: Ueber postoperative leukocytose, Deutsche med. Wchnschr. **31**:1660, 1905.

3. Krumbhaar: Postoperative Leukocytosis in the Dog, Ann. Surg. **66**:133, 1917.

4. Stahl: Deutsche med. Wchnschr. **47**:1550, 1921.

5. Witter, M.: Postoperative Leukocytosis, Surg. Gynec. Obst. **60**:23, 1925.

the duration of the operation and the amount of trauma to the tissues. The type of leukocyte increase was mainly a polyneucleosis, the average of which compared grossly with the average total leukocyte count.

Witter also studied temperature reactions in adults, and found that the temperature does not rise synchronously with the rise in leukocytes, but reaches its height several hours later. She found that while the average temperature curve after that time roughly paralleled the leukocyte curve there were many variations in individual cases, and could not prove that a definite rise in temperature was always accompanied by a proportionate increase in leukocytes. Her material was, however, too limited for general conclusions.

Lindner [6] studied the relation of the eosinophils to the postoperative leukocyte rise.

No extensive studies have been made on the postoperative leukocyte rise in children, and no special observations have been made to ascertain whether any differences occur between children of varied age groups.

The relation, if any, of temperature after operations to the rise and fall of leukocytes in childhood seems also to have escaped investigation.

METHOD OF STUDY ON 147 CHILDREN

In the present studies, which were pursued in the surgical wards of the Children's Hospital, Washington, D. C., the records of 147 children who had tonsillectomy performed were analyzed, having first been arranged into four groups according to age: Group 1, children from 1 to 5; group 2, children from 5 to 7; group 3, children from 7 to 10, and group 4, children from 10 to 13 years.

These groups were chosen after graphs had been made of the leukocyte changes in children of each age from 1 to 13 before operation, four and twenty-four hours after operation. The general trend of these graphs was then noted, and when marked differences in them occurred between the ages, such differences were taken as the starting point for collective grouping.

In adults, Witter found that the maximum rise of leukocytes occurred from four to six hours after operation. To ascertain whether or not this also obtained in children, we had leukocyte estimations made at two hour intervals before and after operation in children of various ages, until eight hours had elapsed, then estimations were made at a four hour interval. The graph of these observations showed that the leukocytes rose rapidly after operation and reached their maximum at from four to six hours afterward, remaining at that height for variable periods depending on the age of the subject. The time of maximum rise coin-

6. Lindner, A. M.: Postoperative Leukocytosis and Eosinophilia, Thesis, in Manuscript, Surgeon General's Library, Washington, D. C.

cided with the observations of Witter made on adults, and was made the basis of our time division.

The temperature was also taken, and both total leukocyte and differential counts of the blood were made before operation, from four to five hours after operation and twenty-four hours after operation. The results were arranged in tables.

Both the temperature and the blood records were obtained at the same hours in relation to the operation, in order to standardize the results. The children were operated on between the hours of 12 m. and 1 p. m. The temperature record and first blood specimen was taken between 11 a. m. and 12 m. The other observations were made from four to six hours later, and the last observations twenty-four hours after operation. No food was given for a period of twelve hours prior to operation. Small quantities of liquid food were taken six, twelve, six-

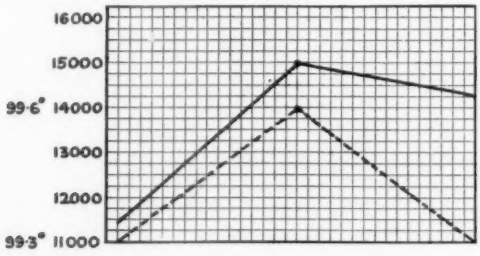

Chart 1.—Average for leukocytes and temperature in all groups. Continuous line, average leukocyte count; broken line, average temperature.

teen and twenty hours after operation. The records of a number of cases not conforming to these requirements were rejected, as well as all those showing a rectal temperature of 100, or over, before operation. The records of a small number of infants under 1 year of age, in which the early operation might presuppose some abnormal physical condition, were also not included.

THE RELATION OF TEMPERATURE TO POSTOPERATIVE LEUKOCYTOSIS

The average leukocyte count before operation of the entire group was 11,400. The average five hours after the operation was 15,000; twenty-four hours after operation this had fallen from 15,000 to 14,250 (chart 1).

The average temperature before operation of the entire group was 99.3 F.; twenty-four hours after operation it was the same as the preoperative temperature.

Chart 2 has been arranged on the temperature basis of 0.1 F. to 1,000 leukocytes. A certain parallelism is seen between the temperature line

and the leukocyte rise five hours after operation. But while the leukocytes remained almost at the maximum twenty-four hours after the operation, the temperature had fallen to the base line. This, as will be seen, is considerably modified in the graphs of observations on children grouped according to age. The average age of the children was 7.25 years.

The relation of lymphocytes to polymorphonuclear leukocytes was also studied for the entire group (chart 3). Before operation the polymorphonuclears were 55 per cent, the lymphocytes 43 per cent. The

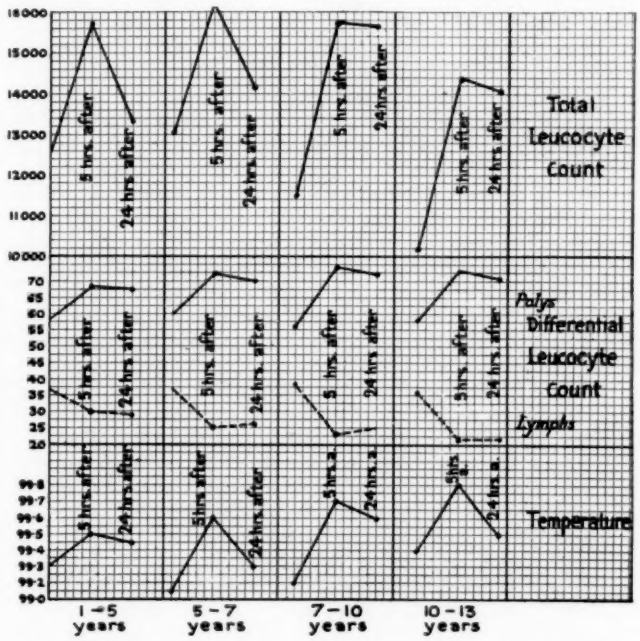

Chart 2.—Postoperative leukocytosis and temperature changes after tonsillectomy; influence of operation.

polymorphonuclears rose five hours after the operation to 70 per cent, while the lymphocytes dropped to 28 per cent. Twenty-four hours afterward the polymorphonuclear increase was sustained, but the lymphocytes dropped to 26 per cent. The proportion of eosinophils and transitionals was about normal at all times.

THE INFLUENCE OF AGE ON THE TOTAL LEUKOCYTES

The blood picture of the individual groups of children aged from 1 to 5, 5 to 7, 7 to 10, and 10 to 13 years shows differences from the average which are marked (fig. 4). The age period at which the greatest dif-

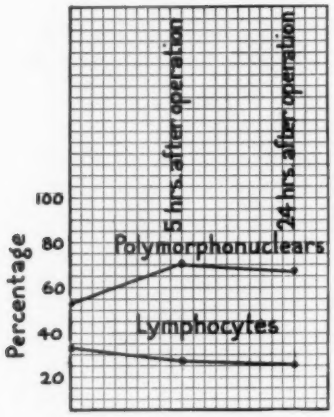

Chart 3.—Average for all groups. Differential count.

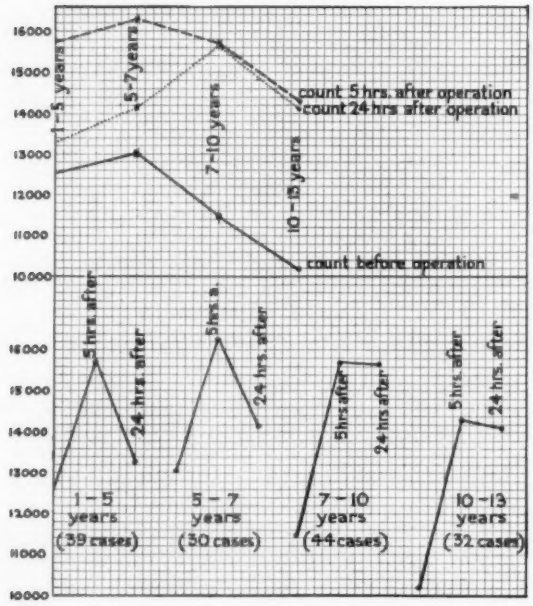

Chart 4.—Influence of age on changes in total leukocytes.

ference is noted begins at 6 to 7 years. In the first group showing the leukocyte count for each age group before, five hours after, and twenty-four hours after, the operation, the leukocyte count before operation was 12,538, five hours after 15,765 and twenty-four hours after 13,272.

In the age group of 5 to 7 years, the leukocyte count before the operation was slightly higher, being 13,036; five hours after operation it was 16,285; twenty-four hours after, 14,181—the chart being somewhat similar to that of the 1 to 5 year group, except that the leukocytosis was slightly higher after twenty-four hours in the older group.

In the age group of 7 to 10, however, the leukocyte count before operation was much lower, being 11,443; but five hours after operation it was still high, 15,722, and remained almost at this level after twenty-four hours—being at that time 15,624.

The same picture is seen in the groups of ages from 10 to 13. Here the leukocyte count before operation was 10,199, five hours after operation 14,278, and twenty-four hours after, 14,123.

The average difference of about 1,000 was found between the groups of ages younger than 7, and the groups older than 7 when the number of leukocytes before was compared with that seen five hours after operation. Before operation, the average leukocyte count was from 1,500 to 2,000 cells higher in the children of the two earlier grouped ages than in those aged from 7 to 10 and from 10 to 13.

THE INFLUENCE OF AGE ON LEUKOCYTOSIS

In chart 4, a continuous line represents the leukocyte count before the operation, with the variations produced in it by age. It begins at 12,538 in children up to the fifth year, rises slightly, to 13,036 in children from 5 to 7 years, drops sharply to 11,443 in children from 7 to 10, and still further to 10,199 in children from 10 to 13. Almost a parallel to this is seen in the dash line representing the leukocyte counts in children five hours after operation. Age influences this to a much less degree, and only a slight increase in the difference between the proportion of the postoperative cell count and that taken after five hours is noted in the groups older than seven years. The average difference up to this age was about 3,200; after this age 4,200 to 4,300.

But in the dotted line, showing the effect of age grouping on the leukocyte changes twenty-four hours after operation, a different picture is shown. This line began at 13,272 in children up to 5 years, increased to 14,181 in children from 5 to 7, rose still further to 15,624 in the group from 7 to 10, and dropped back to 14,123 in those from 10 to 13—showing again the tendency toward the persistence of the higher leukocyte count in children older than 7, as compared with those less than this age when estimated twenty-four hours after the operation.

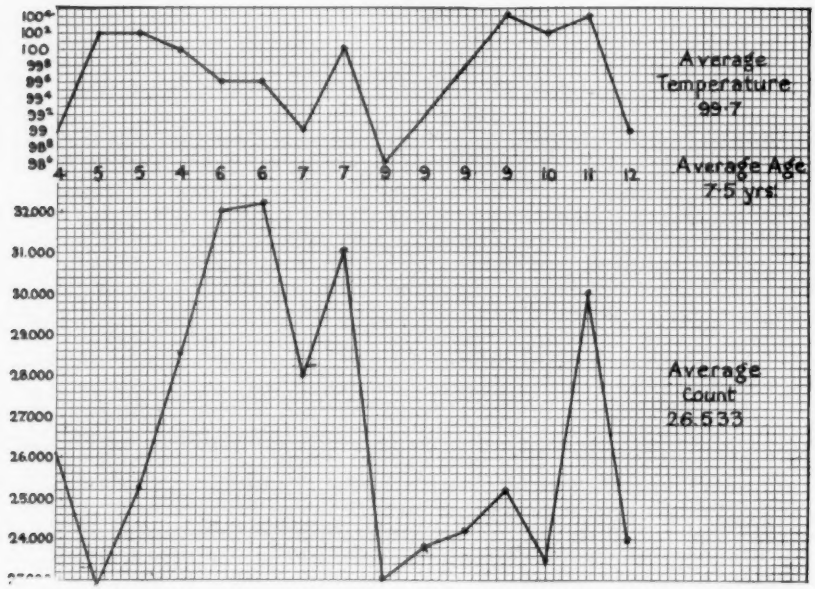

Chart 5.—Fifteen highest leukocyte counts five hours after operation compared with temperature.

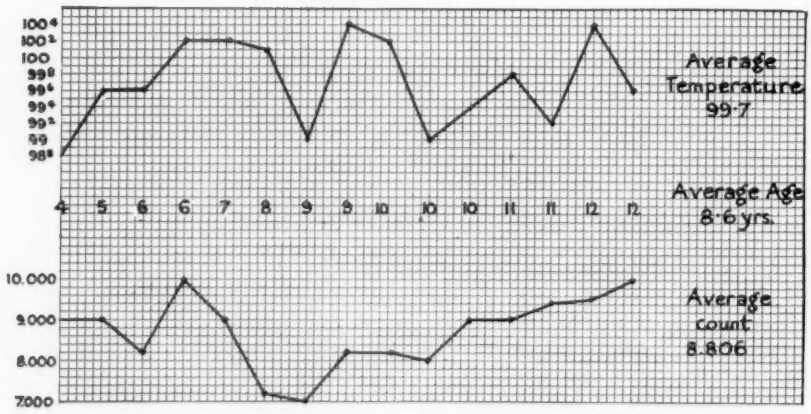

Chart 6.—Lowest fifteen counts five hours after operation compared with temperature.

In the next chart the temperature changes are correlated with the differential leukocyte count and the total leukocyte count, according to the age groups previously spoken of.

The temperature was taken by rectum. In these grouped ages, no striking parallelism is seen between the changes in leukocytes and in temperature, when both are studied before operation and five and twenty-four hours afterward. But it will be noted that the children older than 7 have a slightly higher temperature five hours after operation than those younger, although those younger have a higher leukocyte count at this time. Twenty-four hours after operation the temperature line tends to remain higher in the older than in the younger groups, to an extent approaching but not paralleling the sustained leukocytosis.

The differential changes previously noted in the leukocytes are shown here graphically for comparison with the other data. A polymorphonuclear leukocytosis is the picture, which changes little in relative degree at various ages. Two charts (5 and 6) showing the fifteen highest leukocyte counts and the fifteen lowest leukocyte counts each, with the corresponding temperature curve, show that the degree of leukocytosis within the first twenty-four hours has no relation to temperature variation. The average high leukocyte count was 26,533; the average low leukocyte count was 8,806. The average temperature for both groups was 99.7 F.

SUMMARY

In 147 children, aged from 1 to 13 years, the blood leukocytes were studied before the operation for tonsillectomy, five and twenty-four hours afterward, respectively. The average rectal temperature before operation was found to be 99.3; five hours after operation it was 99.6; twenty-four hours after it was again 99.3 F. When the data were studied, as obtained from children arranged in age groups, the variation in temperature was slight, and such variations as occurred did not parallel the leukocyte changes. The maximum rise in leukocytes was found from four to five hours after operation regardless of the influence of age.

In these children, the average leukocyte count before operation was 11,300, five hours afterward 15,000, and twenty-four hours afterward 14,500. In the children over 7 years of age, the rise of leukocytes five hours after operation approximated the average of 14,500, but twenty-four hours afterward it was 14,875, as compared with 13,725, over 1,000 higher than the average for children younger than 7. A higher initial leukocyte count was also noticed in children less than 7 years of age, the figures being about 12,800 in those younger as compared with 10,750 in those older. In the age groups below 7, a rise of less than 1,000 leukocytes was noticed when the differences between the white cell counts made before operation and twenty-four hours afterward were compared.

But in the age groups from 7 to 13, a rise of slightly over 4,000 leukocytes was noticed when the difference between the white cell counts made before operation and twenty-four hours afterward were compared.

While the leukocytes of the four age groups showed a rise five hours after operation, amounting to about 3,000 in the first two groups, and to 4,000 in the second two groups, the children in the first two groups showed a recession of 2,000 in the leukocyte count twenty-four hours after operation, which amounted to an ultimate increase of about 1,000 over the preoperative count; while the second two groups of children showed practically no such recession, and twenty-four hours after the operation retained their increase of about 4,000 leukocytes over the preoperative count.

From the evidence of this series of cases, therefore, an increase of leukocytes of from 3,000 to 4,000 may be expected five hours after operation.

In children aged from 1 to 7, twenty-four hours after operation this increase falls to a figure about 1,000 higher than the preoperative figure, but in children older than this, the increase at this time amounts to from 3,000 to 4,000. The leukocyte increase or decrease up to twenty-four hours after tonsillectomy has no demonstrable relation to increased temperature, since averages in fifteen cases varying in leukocyte count from 25,633 to 8,806 were found to show an identical average temperature of 99.7 F.

SERUM TEST (TUBERCUMET) FOR ACTIVE TUBERCULOSIS

REPORT OF RESULTS ON ONE HUNDRED PATIENTS*

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CHICAGO

Since the Wassermann test was devised and has proved of such valuable aid in the diagnosis of syphilis, attempts have been made to devise a similar test for the diagnosis of active tuberculosis.

The complement-fixation test was thought for a time to fulfil the requirements of a test for activity. It has been largely dropped, as it was found to be positive in nontuberculous persons, negative in tuberculous persons and either positive or negative in those nonactively tuberculous. At present, the flocculation test belonging to the precipitin group of reactions is receiving most attention. Some observers claim that it is a specific test for active tuberculosis; others find it negative in many patients actively tuberculous and positive in those nonactively tuberculous. The results of a greater number of observers will be necessary to prove its true value.

In the summer of 1925, Eli Lilly and Company advertised by literature and introduced by detail men a test for active tuberculosis, with a substance known under the trade name of tubercumet and the test by the same term.

The nature of the material was defined as a water-soluble extract of a derivative of the tubercle bacillus, that it was in the nature of an antigen, and that, pending further investigation, the test could be looked on as a precipitin reaction. Before being offered to the profession, the test had been tried by three unnamed observers, who had been impressed with its probable usefulness and who reported a total percentage error of about 7.

Since October, 1925, the serums of more than 125 patients, infants and children in the dispensary of Northwestern University Medical School have been tested. Because of inability to complete all work thought necessary on each patient by reason of their failure to return, I have included in this report the results of tests of only 100 patients.

In making the tubercumet test, we tried, and I believe succeeded, to fulfil all the requirements in technic as outlined by the manufacturer, namely, clean pipets, serum not more than forty-eight hours old (ours was never more than thirty hours old), serum taken at least two hours after eating to avoid lipoids, and reading of the test for at least two hours after incubation.

* Received for publication, Aug. 11, 1926.

TABLE 1.—*Observations in Fifty Cases*

Case	Name	Age	Diagnosis or Complaint	Tuberculin Test	Pirquet Test	Intradermal Test	Roentgen-Ray Examination	Wassermann Reaction	Blood Test	Urinalysis
1	A. R.	1 yr.	Tuberculous pneumonia	Strong positive	Positive	Both positive	Area of consolidation, right lung	.....	.....	.....
2	R. B.	8 yr.	Unresolved pneumonia	Positive	Negative	0.05 mg. bovine tuberculin negative; 1 mg. human negative	Fan shaped shadows into apexes	.....	.....	.....
3	E. L.	2 yr. 7 mo.	Tuberculous bronchopneumonia; tuberculous peritonitis	Positive	.....	Both bovine and human tuberculin strong positive	Tracheobronchial glands, pleural shadows	Negative	.....	.....
4	G. C.	11 yr.	Otitis media.....	Positive, 4/23/26; positive, 5/28/26	Negative	0.01 mg. negative; 0.05 mg. negative	.....	.....	....	.....
5	G. S.	10 yr.	Cervical Potts disease	Strongly positive	Slightly positive	.....	Negative.....	.....	4,240,000, hemoglobin 85 per cent	Negative
6	W. B.	2 yr.	Phlyctenular conjunctivitis	Strongly positive	Strongly positive	.....	Dense area, right middle lobe	.....	4,600,000, hemoglobin 80 per cent	.....
7	L. J.	8 yr.	Mitral and aortic regurgitation; rheumatism	Positive	Negative	0.05 mg. human negative; 0.05 mg. bovine negative; 1 mg. human negative	.....	.....	.....	.....
8	A. A.	1 yr. 4 mo.	Rickets, malnutrition	Strong positive, 12/5/25; positive, 5/26/26	.....	Strong positive	Right lung field dense; right phrenic angle obliterated due to pleural thickening	.....	.....	.....
9	H. C.	13 mo.	Frequent colds; bronchitis; exposed to tuberculosis in sister	Positive	Positive	Positive	Tracheobronchial glands; marked hilum shadow; diffuse lung mottling	.....	4,900,000, hemoglobin 85 per cent	.....
10	J. B.	19 mo.	Rickets and phlyctenular conjunctivitis	Positive	Strong positive	.....	Marked hilum shadows, probably caseating peribronchial and tracheobronchial glands	.....	.....	.....
11	R. H.	18 mo.	Rickets, pharyngitis....	Positive	.....	Both slightly positive	.....	.....	.....	.....
12	J. H.	4 yr.	Acute cold.....	Positive	.....	0.05 mg. negative.....	Positive hilum shadow	.....	.....	.....
13	A. H.	11 yr.	Malnutrition.....	Positive	Slightly positive	Slightly positive	Increased hilum and pulmonary markings	.....	....	.....
14	J. C.	9 yr.	Tuberculous contact in brother; otherwise well	Positive	.....	Both slight, left more positive	Shows dense pulmonary markings	.....	.....	.....
15	M. S.	2 yr.	Frequent colds; bronchitis	Strong positive	.....	0.01 mg. bovine negative; 0.05 mg. bovine negative; 1 mg. human positive	Dense shadow left lobe, mottling left side	.....	.....	.....
16	R. J.	1 yr. 4 mo.	Six weeks after pneumonia	Strong positive	Positive	Positive	Increased hilum and pulmonary markings, fan-shaped into periphery	Negative	.....	.....
17	S. M.	14 yr.	Phlyctenular conjunctivitis; otherwise strong child	Strong positive	Negative	0.01 mg. human positive	Negative.....	Negative	.....	.....

18	D. L.	11 yr.	Malnutrition 18 per cent	Strong positive	Negative	.....	.....	Negative	Normal	.....
19	M. H.	6 yr.	Phlyctenular conjunctivitis	Strong positive	Negative	0.01 mg. human tuberculin positive	Fan-shaped infiltration into right upper lobe	Negative	Normal	.....
20	R. S.	25 mo.	Tuberculous contact at age of 5 months; robust child	Positive	Positive	0.01 mg. human tuberculin positive	.....	.....	4,500,000, hemoglobin 60 per cent	.....
21	M. A.	6 yr.	Bronchitis; positive D'Espine's sign	Positive	Positive	0.01 mg. human tuberculin positive	Large hilum shadow right side, more than usual bronchial markings	.....	Normal	.....
22	J. D.	3 yr.	Tuberculous glands of neck	Positive; repeat, 3 mo., positive	Positive	0.01 mg. human tuberculin positive	Increased hilum shadows and tracheobronchial glands	Negative	Normal	.....
23	M. F.	2 yr.	Tuberculous cervical glands; tuberculous pneumonia	Positive	Positive	0.01 mg. human tuberculin positive	Tracheobronchial glands. consolidation left upper	Negative	.....	.....
24	F. S.	4 yr.	Tuberculous glands of neck	Strong positive	Positive	.....	Positive hilum glands, and tracheobronchial glands	.....	.....	.....
25	B. H.	8 yr.	Malnutrition and congenital syphilis	Positive; repeat, 2 mo., slightly positive	Negative	0.05 mg. bovine, 1 mg. human negative	Negative.....	Positive	5,000,000, hemoglobin 80 per cent	.....
26	E. R.	2½ yr.	Rickets and tuberculous	Positive	Positive	0.01 mg. positive.....	Consolidation left upper	Negative	4,300,000, hemoglobin 65 per cent	.....
27	L. P.	11 mo.	Tuberculous contact in mother	Positive	.....	0.01 mg. bovine tuberculin positive; same amount human positive	Marked gland shadow, increased hilum markings	.....	.....	.....
28	W. C.	10 mo.	Tuberculous pneumonia at 4 mo. of age	Positive at 10 mo.	Positive	.....	Area of consolidation persisting 4 to 10 months; repeated roentgen rays	Negative	Normal	Negative
29	W. G.	6½ yr.	Persistent cough; positive D'Espine's sign	Positive	Positive	0.01 mg. positive.....	Marked increased hilum and bronchial markings	.....	Normal	Trace of albumin
30	V. G.	2 yr.	Rickets, chronic pyelitis	Positive Jan. 1, 1926; positive April 17, 1926	Twice negative	0.01 mg. negative 2/5/26; 0.05 mg. negative 4/10/26; 0.05 mg. bovine negative 6/2/26; 1 mg. human positive	Increased hilum and bronchial markings	.....	3,400,000, hemoglobin 70 per cent	Negative
31	M. G.	4 yr.	No complaint; other children had positive tuberculmet test	Positive	Positive	.....	Increased hilum and bronchial markings	.....	3,500,000, hemoglobin 80 per cent	Negative
32	K. J.	10 yr.	Eye injury simulating phlyctenular conjunctivitis	Positive April 12, 1923; negative May 25, 1926	.....	0.01 mg. human strongly positive; 0.01 mg. bovine positive	Fan-shaped shadows into apexes from hilum	Negative	Normal	Negative
33	J. M.	3 yr.	Rickets.....	Strong positive	Negative	0.01 mg human and bovine negative; 0.05 mg. bovine negative; 1 mg. human positive	Marked hilum increased shadow	Negative	Normal	Normal
34	M. M.	8 yr.	Submental gland adenitis, acute	Positive 2/15/26; negative 5/26/26	Negative	0.01 mg. bovine negative 2/15/26; 1 mg. human slightly positive 5/26/26	Negative.....	Negative	.....	.....

TABLE 1.—*Observations in Fifty Cases—Continued*

Case	Name	Age	Diagnosis or Complaint	Tuberculin Test	Pirquet Test	Intradermal Test	Roentgen-Ray Examination	Wassermann Reaction	Blood Test	Urinalysis
35	C. B.	1 yr.	Rickets, bronchitis.....	Positive	Negative	0.01 mg. positive.....	Marked hilum shadow	Negative	.....	.....
36	E. C.	2 yr.	Rickets, pharyngitis....	Positive	.....	0.01 mg. negative.....	.....	Negative	.....	.....
37	M. L	10 yr.	Tuberculosis of knee joint; positive D'Espine's sign	Strong positive	Positive	0.01 mg. positive.....	Tracheobronchial glands, increased shadows in periphery	.....	Normal	.....
38	D. M.	5 yr.	Spina ventosa middle left finger, right metatarsal	Positive	Negative	0.01 mg. negative, 0.05 mg. human and bovine positive (slight)	Slight increased pulmonary markings	Negative	Normal	Negative
39	L. M.	6 yr.	Tuberculous adenitis, cervical	Positive	Positive	0.01 mg. positive.....	Tracheobronchial glands	Negative	3,500,000, hemoglobin 85 per cent	.....
40	J. P.	6 yr.	Malnutrition, persistent cough	Positive	Negative	0.01 mg. human and bovine tuberculin negative; 1 mg. human doubtfully positive	Negative.....	.....	Normal	Negative
41	G. M.	7 yr.	Malnutrition; father died of tuberculosis; stepfather had tuberculosis	Strong positive	Negative	.....	Negative.....	.....	.....	.....
42	J. M.	12 yr.	Malnutrition; tuberculosis in father	Positive	.....	0.05 mg. positive.....	Increased hilum and pulmonary markings, dense throughout, extending into apexes and bases	Negative	4,510,000, hemoglobin 85 per cent	Negative
43	F. C.	6 yr.	Postwhooping cough	Strong positive	Negative	0.05 mg. human and bovine tuberculin positive	Increased hilum and pulmonary markings	.....	4,5[illegible]0,000, hemoglobin 80 per cent	Negative
44	A. C.	8 yr.	Chorea.....	Strong positive	Strong positive	.....	Negative.....	.....	4,500,000, hemoglobin 85 per cent	.....
45	R. G.	5 yr.	Endocarditis; mitral regurgitation	Positive	Negative	0.05 mg. bovine negative; 1 mg. human negative	Enlarged heart, otherwise negative	....	5,600,000, hemoglobin 85 per cent	Negative
46	J. A.	16 mo.	Postencephalitis.....	Strong positive	.....	0.05 mg. human and bovine negative; 1 mg. human positive	Hilum shadow increased on right side, extending into intermediate area	.....	6,000,000, hemoglobin 60 per cent	Negative
47	C. R.	8 yr.	Fractured arm.....	Positive	.....	0.05 mg. bovine negative; 1 mg. human negative	Normal.....	.....	5,960,000, hemoglobin 82 per cent	Negative
48	N. Y.	16 mo.	Malnutrition.....	Positive	.....	0.05 mg. human and bovine negative; 1 mg. human positive	Negative.....	.....	5,080,000, hemoglobin 80 per cent	Negative
49	M. Z.	8 mo.	Eczema.....	Positive	.....	0.05 mg. human and bovine negative; 1 mg. human negative	Negative.....	.....	6,040,000, hemoglobin 65 per cent	Negative
50	A. S.	15 mo.	Septicemia; abscess of thigh; abscess of scalp; periostitis	Positive	.....	0.05 mg. human and bovine negative; 1 mg. human negative	Acute respiratory findings	.....	3,060,000, hemoglobin 60 per cent	Negative

Miss O. E. Hepler, a trained laboratory worker, performed all the tests. She is in charge of the medical laboratory at the Medical School, and has had a great deal of experience in laboratory technic, in Wassermann reactions, etc. The test is performed as follows: A dry syringe is used to draw the blood. In our cases the syringes were autoclaved and dried perfectly. This is to prevent water from causing hemolysis of the blood cells and consequent clouding of the serum. The serum is placed in a small test tube 5 mm. in diameter, and the same amount of tubercumet is overlaid. In positive tests an opacity occurs between the tubercumet material, similar to an albumin ring. It can be interpreted in the usual +, ++, +++, and ++++. The terms have been used. The general plan of the work was this: In each child whose blood was tested, an attempt was made to perform a Pirquet skin test or an intradermal test with 0.01 mg. of tuberculin, a blood count, a roentgen-ray examination and a urinalysis. If the tubercumet test was positive and the skin tests were negative, a larger dose of tuberculin was given intradermally, usually 0.05 mg. In a considerable number, in which it was felt that the tubercumet test was not in agreement with the clinical observations of the child, 1 mg. of tuberculin was used intradermally (table 1).

There was a total of fifty positive or strongly positive tests. In sixteen of these (table 1, cases 1, 3, 5, 8, 10, 22, 23, 24, 26, 27, 28, 29, 35, 37, 38 and 39), clinical examination showed that the patients were actively tuberculous. In five cases (table 1, cases 6, 9, 16, 21 and 33), they were probably actively tuberculous. In sixteen cases (11, 12, 13, 14, 15, 17, 18, 19, 20, 31, 32, 36, 41, 42, 43 and 44), tests showed that the patients might be actively tuberculous because of agreement of skin tests, but this was doubtful because of lack of clinical manifestations; and in one (case 32), the test, repeated after six weeks, was negative, the child on both occasions showing no evidence of active tuberculosis, having good color, having increased in weight and having a good appetite. In thirteen cases (2, 4, 7, 25, 30, 34, 40, 45, 46, 47, 48, 49 and 50) in which skin tests were repeated in enlarging doses, and in which the patients were clinically well, the test was in frank disagreement.

The percentage of almost certain error, then, is 26. If the cases of the robust, well-nourished child and the patient with chorea under observation in the hospital (case 44) are included, fifteen cases are in disagreement, with an error of 30 per cent. Accepting an active tuberculosis in the remaining clinically well group and the five with probably active tuberculosis, the test was positive in 74 per cent. If, on the other hand, these sixteen doubtful cases are included in the percentage of error, there would be an error of 58.

TABLE 2.—*Observations in Twenty-Six Cases*

Case	Name	Age	Diagnosis or Complaint	Tubercumet Test	Pirquet Test	Intradermal Test	Roentgen-Ray Examination	Wassermann Reaction	Blood Test	Urinalysis
1	J. B.	3 yr.	Well now, phlyctenular conjunctivitis at 6 months	Weak positive	.....	0.01 mg. bovine positive; human negative	Negative.....	.....	Normal	.....
2	B. M.	8 yr.	Chronic tonsillitis.....	Weak positive	.....	0.01 mg. negative.....	Negative.....	.....	5,750,000, hemoglobin 85 per cent	.....
3	M. B.	7 yr.	Otitis media.....	Weak positive	.....	0.05 mg. negative.....	Negative.....	.....	.....	.....
4	E. W.	5 yr.	Enuresis.....	Weak positive	.....	0.01 mg. human and bovine tuberculin, both slightly positive	Marked shadows extending to apexes from hilum	.....	.....	.....
5	F. K.	5 yr.	Tuberculous contact...	Weak positive	.....	0.01 mg. human and bovine, both positive; human tuberculin more so	Hilum and pulmonary markings show considerable increase	.....	.....	.....
6	J. M.	8 yr.	Tonsillitis, 12 per cent underweight	Weak positive	Negative	.....	Negative.....	.....	.....	.....
7	L. G.	7 yr.	Chronic otitis; tuberculosis (?)	Weak positive	Negative	0.01 mg. human negative	.....	.....	Normal	.....
8	G. W.	7 yr.	Tuberculous glands of neck	Weak positive	.....	.....	.....	++++ positive	.....	.....
9	J. C.	6 yr.	Chronic bronchitis.....	Weak positive	Negative	0.05 mg. human negative	Negative.....	.....	Normal	Normal
10	M. E.	6 yr.	Phlyctenular conjunctivitis	Weak positive	Positive	0.01 mg. human tuberculin positive	Beading shadows into apexes	Negative	4,700,000, hemoglobin 75 per cent	.....
11	L. R.	9 mo.	Rickets, congenital syphilis, tuberculous bronchial pneumonia	Weak positive 12/23/25; strongly positive 4/17/25	Positive	0.01 mg. human tuberculin positive	Dense markings in both lungs as in bronchopneumonia	++++ positive	Normal	.....
12	Leon R.	3 yr.	Pyelitis.....	Weak positive 10/24/25; strongly positive 2/26/23	.....	0.05 mg. human and bovine negative	Negative.....	Negative	Normal	.....
13	N. C.	2 yr. 2 mo.	Active tuberculosis in mother; malnutrition, otherwise well	Weak positive	Negative	0.05 mg. human tuberculin negative	Peribronchial glands, (hilum)	.....	.....	Normal

14	H. H.	8 yr.	Acute bronchitis.....	Weak positive	Negative	0.05 mg. tuberculin negative	Negative.....	.....	.....	.....
15	W. H.	2 yr.	Unresolved pneumonia at the base	Weak positive	Negative	0.05 mg. human and bovine tuberculin negative	Taken after lung clinically well, negative	.....	.....	Negative
16	L. H.	5 yr.	No complaint except umbilical hernia	Weak positive	Negative	0.01 mg. human tuberculin negative	Some hilum shadow increase	.....	.....	Negative
17	Harold H.	11 yr.	Acute bronchitis.....	Weak positive	Negative	0.01 mg. human tuberculin negative	Slight increase hilum markings	Negative	Normal	.....
18	P. K.	5 yr.	Discharging tuberculous glands of neck	Weak positive	Positive	.....	.....	Negative 3 times, positive 3 times	Normal	.....
19	G. M.	20 mo.	Rickets.....	Weak positive	Negative	0.01 mg. human and bovine tuberculin negative	Diffuse shadows of bronchopneumonia	.....	4,000,000, hemoglobin 80 per cent	.....
20	N. Y.	3 yr.	Cervical adenopathy...	Weak positive	Negative	0.01 mg. human tuberculin negative	.....	.....	.....	.....
21	B. M.	7 yr.	Tuberculosis in father; malnutrition	Weak positive	.....	0.05 mg. human and bovine tuberculin negative	Increased hilum and pulmonary markings, fan-shaped into apexes	Negative	5,180,000, hemoglobin 90 per cent	Negative
22	J. M.	6 yr.	Tuberculosis in father; malnutrition	Weak positive	.....	0.05 mg. human and bovine tuberculin negative	Increased pulmonary markings, marked	Negative	3,800,000, hemoglobin 65 per cent	Negative
23	L. C.	2½ yr.	Postwhooping cough...	Weak positive	Negative	0.05 mg. human and bovine tuberculin negative	Increased hilum and pulmonary markings, commonly seen in whooping cough	.....	5,430,000, hemoglobin 80 per cent	Negative
24	M. D.	2¼ yr.	Rickets, pharyngitis....	Weak positive	.....	0.05 mg. human and bovine tuberculin negative	Large heart and thymus shadow	.....	4,120,000, hemoglobin 90 per cent	Negative
25	E. E.	10 yr.	Pseudohypertrophic muscular dystrophy	Weak positive	Negative	0.05 mg. human and bovine tuberculin negative; 1 mg. human tuberculin positive	Negative.....	.....	5,200,000, hemoglobin 82 per cent	Negative
26	J. B.	7 yr.	Endocarditis mitral regurgitation	Weak positive	Positive	.....	Enlarged heart, otherwise negative	.....	4,200,000, hemoglobin 75 per cent	Negative

TABLE 3.—*Observations in Twenty-Four Cases*

Case	Name	Age	Diagnosis or Complaint	Tuberculmet Test	Pirquet Test	Intradermal Test	Roentgen-Ray Examination	Wassermann Reaction	Blood Test	Urinalysis
1	R. P.	20 mo.	Pharyngitis and malnutrition	Negative	Negative	0.01 mg. human tuberculin negative	.....	.....	.....	.....
2	L. T.	2 yr.	Malnutrition and repeated colds	Negative	Negative	0.01 mg. human tuberculin negative	.....	.....	.....	.....
3	C. J.	1 yr. 2 mo.	Rickets.....	Negative	Negative	0.01 mg. human tuberculin negative	.....	.....	4,960,000, hemoglobin 70 per cent	.....
4	D. L.	10 yr.	Headaches.....	Negative	Negative	0.01 mg. human and bovine tuberculin negative	Increased bronchial markings	++++	.....	.....
5	M. P.	10 yr.	Chronic bronchitis, râles right apex and left base	Negative	Negative	0.01 mg. bovine negative; 1 mg. human positive	Fan-shaped markings into apexes and bases; calcified areas	.....	.....	.....
6	W. P.	9 yr.	Exposure to tuberculosis in father	Negative	.....	0.01 mg. human and bovine tuberculin positive; human more so	Marked infiltrative shadows, increased hilum shadows extending into base of lung	.....	.....	.....
7	S. T.	4 yr.	Healed tuberculosis, tuberculous pneumonia at 7 months of age; phlyctenular conjunctivitis at 2 years	Negative	Positive	0.01 mg. human tuberculin positive	Negative at times of test; area of consolidation in previous roentgen rays from 7 months to 2 years of age	Negative	.....	.....
8	E. W.	8 yr.	Thirteen per cent underweight; persistent cough	Negative	Strong positive	.....	Increased bronchial and pulmonary markings	Negative	Normal	.....
9	J. R.	6 yr.	Acute bronchitis.....	Negative	Negative	0.01 mg. human tuberculin strongly positive	Negative.....	Negative	.....	.....
10	T. J.	6 yr.	Phlyctenular conjunctivitis	Negative	Positive	0.01 mg. human tuberculin strongly positive	Marked shadow around hilum	.....	Normal	.....
11	H. V.	9 yr.	Twenty-two per cent underweight	Negative, repeated negative	Positive	0.01 mg. strongly positive	Positive tracheobronchial glands	.....	Normal	.....
12	W. B.	6½ yr.	Decreased resonance left apex	Negative	Negative	0.01 mg. human tuberculin negative	Large hilum shadow right side	.....	Normal	.....

13	R. C.	10 yr.	Malnutrition and cervical adenotitis	Negative	Positive	.....	Small calcified areas	Negative	.....	.....
14	A. F.	5 yr.	Congenital syphilis.....	Negative	.....	0.05 mg. bovine tuberculin; 1 mg. human tuberculin negative	Negative.....	Positive	.....	.....
15	E. P.	3 yr.	Subacute otitis tuberculosis of spine	Negative	.....	.....	Negative lung plate, positive tuberculous spine	.....	.....	.....
16	C. C.	9 yr.	Malnutrition and deafness	Negative	Negative	0.01 mg. human tuberculin negative	.....	Negative	Normal	Negative
17	A. G.	7 yr.	Tuberculous hip (?); three members of family tuberculous; one death from tuberculosis	Negative	Negative	0.01 mg. human tuberculin negative	Negative chest and hip	.....	Normal	Negative
18	L. N.	6 yr.	Acute bronchitis.....	Negative	Negative	.....	Acute respiratory findings of increased bronchial markings	Negative	.....	.....
19	P. A.	6 yr.	Phlyctenular conjunctivitis	Negative 12/5/25; positive 5/26/26	Positive	0.01 mg. human and bovine tuberculin negative 5/28/26; positive 12/5/25	Increased pulmonary markings in both upper lung fields	.....	Normal	.....
20	R. B.	4 mo.	Pyelitis and pertussis..	Negative	.....	0.01 mg. human tuberculin negative	.....	Negative	3,890,000, hemoglobin 75 per cent	.....
21	D. C.	3 yr.	Acute pharyngitis.....	Negative	Slightly positive	.....	.....	.....	.....	.....
22	L. C.	4 yr.	Postwhooping cough...	Negative	Negative	0.05 mg. human and bovine tuberculin negative	Increased hilum and pulmonary markings commonly seen in whooping cough	.....	5,430,000, hemoglobin 80 per cent	Negative
23	W. C.	5 yr.	Tinea tonsurans.....	Negative	.....	0.05 mg. human and bovine tuberculin negative	Negative.....	.....	4,770,000, hemoglobin 75 per cent	Negative
24	H. M.	17 mo.	Scurvy, upper respiratory infection	Negative	.....	0.01 mg. human and bovine tuberculin negative; 0.05 mg. human and bovine negative; 1 mg. human tuberculin negative	Extensive infiltrative shadows in both lungs	.....	3,400,000, hemoglobin 40 per cent	Negative

In the weak positive group, there were twenty-six patients showing a weakly positive test. Three cases (8, 11 and 18) were actively tuberculous clinically. There were fourteen cases (1, 2, 3, 4, 5, 10, 13, 17, 19, 20, 21, 22, 23 and 26) in which the skin tests were also positive, but clinically the children showed no evidence of active tuberculosis. In nine cases, the tubercumet test was in frank disagreement with both clinical manifestations and the skin tests (cases 6, 7, 9, 12, 14, 15, 16, 24 and 25). There was a percentage error in this group of 30, and a possible error of 80 if the patients with clinically nonactive tuberculosis are included.

In the negative group there were twenty-four cases; nineteen were in agreement with clinical observations; in two cases of active tuberculosis (11 and 15) the test was negative—an error of 8 per cent. In three cases of probably active tuberculosis (5, 6 and 8), the test was negative, giving a probable error of 15 per cent if these three cases are included.

The manufacturers claim a prognostic value. In case 3, table 1, a patient with lung and tuberculous peritonitis who died in two weeks, the test was positive. A positive test is supposed to indicate a good resistance; a weak positive test indicates a poor or failing resistance. Another case—tuberculosis of the spine (case 5, table 1), in which the patient was doing badly, gave a strongly positive test. These are marked examples disproving such conclusions.

SUMMARY OF THE WORK

Eighty roentgenograms were taken, and in thirty-three there were definite lung changes, seldom diagnostic alone, but helpful in conjunction with clinical manifestations and the tuberculin skin tests. In many of the roentgen-ray reports the stereotyped diagnosis, increased hilum and pulmonary markings, was made, but these are not included unless marked or differing in some essential from the increased markings of acute and chronic respiratory infections so frequently seen in dispensary patients. Eight of these thirty-three cases with diagnoses of positive tuberculosis showed evidence of tracheobronchial glands. Seven of the thirty-three showed large areas of involvement, which agreed with the clinical picture of tuberculous pneumonia. Six of the thirty-three showed fan-shaped shadows extending from the hilum into apexes or bases, or into both apexes and bases. Two showed the diffuse mottlings of bronchopneumonia. The remaining ten showed increased hilum and pulmonary markings beyond that expected in dispensary patients with frequent respiratory infections. It is my feeling that children with positive skin tests seldom fail to show abnormal roentgen-ray observations, not, however, diagnostic of active or healed tuberculosis alone.

A Pirquet test was made on seventy-four patients, with twenty-seven positive reactions, or a percentage of 36. In four, the Pirquet

reaction was negative when the intradermal was positive, the two tests being run simultaneously in forty cases. Eight per cent, therefore, reacted to the intradermal and not to the Pirquet test, showing the greater sensitiveness of the intradermal test. Eighty-five patients were given an intradermal skin test with from 0.01 to 0.05 mg. of tuberculin —thirty-six of which were positive, or 42 per cent. Thirty-one patients were given both human and bovine intradermal tests, with from 0.01 to 0.05 mg. of tuberculin, with twelve positive reactions to one or both. Only one patient gave a positive reaction to the bovine and not to the human tuberculin, or a percentage of 8. In two cases, the reaction to the bovine was greater than to the human tuberculin. Thirty-five simultaneous Wassermann tests were made with five positive reactions, a percentage of 4. In these five patients with positive Wassermann reactions, one gave a positive tubercumet test, though clinically nontuberculous and with negative repeated skin tests up to 1 mg. of tuberculin intradermally. Two positive Wassermann reactions were obtained in nontuberculous patients who gave negative tubercumet reactions; two were obtained in patients with active tuberculosis who gave positive tubercumet reactions; they, therefore, had a double infection. One case in five in which the Wassermann and tubercumet reactions are positive in a nontuberculous patient hardly warrants any conclusions, but suggests that the test is positive in other infections, syphilis in this instance, rheumatism (case 7), chorea (case 44) and endocarditis (case 45). These children are clinically nontuberculous, react negatively to repeated skin tests, have other infections, and react to the tubercumet test. Thirty urinalyses were made; only one showed a trace of albumin (Roberts' reagent, 2 per cent acid and saturated salt); the other twenty-nine gave negative reactions.

A red blood count and hemoglobin determination (Tallqvist) were made for fifty-nine patients. Eleven of the fifty-nine were in the clinically active tuberculous group. Four showed a secondary anemia, a percentage of 30. There were three cases of secondary anemia in the nontuberculous group, a percentage of 6.

CONCLUSION

In 100 cases, there was a total error of 24, or a percentage error of 24. A 26 per cent error occurred in the positive test cases as a group, a 30 per cent error in the weakly positive group and an 8 per cent in the negative test group. The tubercumet test has been positive in the majority of frankly active tuberculous patients, but has also been positive in those nontuberculous and doubtfully actively tuberculous. Little dependence can, therefore, be placed on the tubercumet test.

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THE TREATMENT OF ERYSIPELAS WITH BLOOD TRANSFUSION *

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In the numerous articles that have been written on erysipelas, a great variety of therapeutic agents have been recommended, most of which have eventually been proved to be ineffectual. Local remedies, comprising all sorts of ointments, compresses, lotions, the collodion ring, the surgical "fence" and, more recently, intravenous antiseptics, have been tried and found to be of no avail. Following Fehleisen's [1] discovery of *Streptococcus erysipelatis,* antistreptococcal serums and vaccines were widely used, only to be discarded later. Recently, a specific serum has been made which gives great promise of proving an effective aid in combating the disease (Amoss,[2] Rivers [3] and Birkhaug [4]).

The interpretation of statistical data is likely to be particularly misleading unless one keeps clearly in mind the extreme variation in mortality in the different age groups. Between the ages of 5 and 50, the average mortality is considerably less than 4 per cent, whereas the curve rises rapidly in both infancy and old age (table 1). When the age period of infancy and childhood is further subdivided, it will be seen that the mortality decreases rapidly from birth to about the fifth year, when it reaches the adult level (table 2). In a series of patients who received only local treatment, Knox [5] found the mortality to be 60 per cent in infants under 6 months. In infants under 1 year, Schliepe's [6] mortality was 78.5 per cent, and Robertson's [7] 56 per cent, while in children of 2 years or less, Erdman's [8] figures were 39.7 per cent. It is difficult, then, to draw conclusions from studies on young

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adults in whom death so seldom occurs even when untreated, whereas striking differences can readily be appreciated in the first quinquennium. It has long been recognized that the occurrence of a secondary blood stream infection carries with it a particularly grave prognosis (Sprunt [9]), and the presence or absence of this complication before the institution of treatment must be noted in the consideration of therapeutic results.

In 1915, Kaiser [10] successfully treated a patient who had post-vaccination erysipelas with an intramuscular injection of whole blood

TABLE 1.—*Reported Mortality in Erysipelas* *

Age Periods	Cases	Deaths	Deaths, per Cent
0 to 5	78	9	11.5
5 to 10	50	2	4.0
10 to 20	186	3	1.6
20 to 30	272	6	2.2
30 to 40	296	11	3.7
40 to 50	345	16	4.6
50 to 60	235	23	9.7
60 to 70	137	14	10.2
70 +	44	11	25.0
Totals	1,643	95	5.7

* Ker, C. B.: Infectious Diseases, London, Oxford University Press, 1920.

TABLE 2.—*Effect of Blood Transfusion in the Harriet Lane Patients*

	Untreated			Treated (Blood Transfusion)		
Age Periods	Cases	Deaths	Deaths, per Cent	Cases	Deaths	Deaths, per Cent
0 to 1 month	10	8	80.0	1	1	100
1 to 6 months	17	9	53.0	8	2	25
6 to 12 months	21	10	47.6	5	1	20
1 to 2 years	14	2	14.3	5	0	0
2 to 5 years	11	1	9.1	0	..	..
5 to 15 years	9	0	0.0	0	..	..
Totals	82	30	36.5	19	4	21

from an adult convalescing from erysipelas. Robertson,[7] in 1924, and Brown [11] in the following year, reported a striking drop in mortality in the patients treated by exsanguination transfusion. As the technic of this procedure is comparatively difficult, it was decided in 1924 to give all children suffering from erysipelas, who were admitted to the Harriet Lane Home, a transfusion of whole citrated blood (about 10 cc. per pound), and if necessary to repeat the procedure once or twice with blood from different donors.

9. Sprunt, T. P.: The Prognostic Value of Blood Cultures in Erysipelas, Bull. Johns Hopkins Hosp. **27**:300-302, 1916.

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11. Brown, A.: The Treatment of Septicaemias and Intoxication in Infants and Children, Wisconsin M. J. **23**:645-652, 1925.

RESULTS

Our results may be seen in table 2. The series is small, unfortunately, but the effect of the treatment in many of the individual cases seemed sufficiently striking and the drop in case fatality significant enough to warrant publication. Only one child less than 1 month of age was seen (an infant, aged 11 days, with the erysipelatous inflammation involving the skin of practically the entire body, and who was obviously moribund on admission), so we are unable to discuss the results of treatment in this age group. In infants aged from 1 to 6 months, it will be seen that only one fourth of the treated group succumbed, as opposed to over one half of the untreated. One fifth of the infants aged from 6 to 12 months who received transfusions died, whereas almost one half died in the corresponding age group of those untreated. None of the

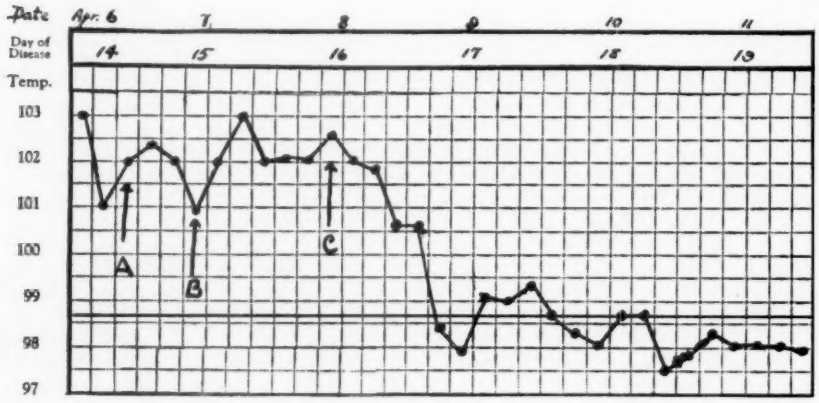

Chart 1.—Temperature of D. R. *A*, 50 cc. of antistreptococcal serum was injected intraperitoneally; *B*, 40 cc. of serum, intramuscularly; *C*, 90 cc. of whole citrated blood, intramuscularly.

children in the second year of life died in the treated group, whereas one seventh of those of the same age who were untreated succumbed. It is significant that the four fatal cases were of such a nature that recovery under any condition seemed impossible. The 11 day old infant had evidently been ill for many days, was literally covered with the lesions of erysipelas, was moribund on admission and survived only twelve hours. One colored infant, aged 3½ months, had developed erysipelas simultaneously in two places, manifested signs of peritonitis several hours later and had numerous colonies of hemolytic streptococci in each cubic centimeter of blood before treatment. Another, a poorly nourished white infant, aged 3 months, developed erysipelas of the scalp as a terminal event during a downward course subsequent to an operation for strangulated hernia. The fourth fatality in the series of infants who had received transfusion was that of a 9 months old child who had

suffered from severe diarrhea for ten days, was admitted moribund with facial erysipelas, extensive bronchopneumonia, otitis media and septicemia.

The patients may be divided into three groups on the basis of their reactions to transfusion. In the first group, the temperature fell almost immediately to normal, and remained so, while the spread of the cutaneous lesion was completely checked after advancing for from twelve to eighteen hours. In the second and largest group, the temperature either fell by rapid lysis or after a critical drop, rose to a lower level, subsiding gradually to the normal within a few days. In the third group comprising three patients, no reaction to one or more transfusions was manifest.

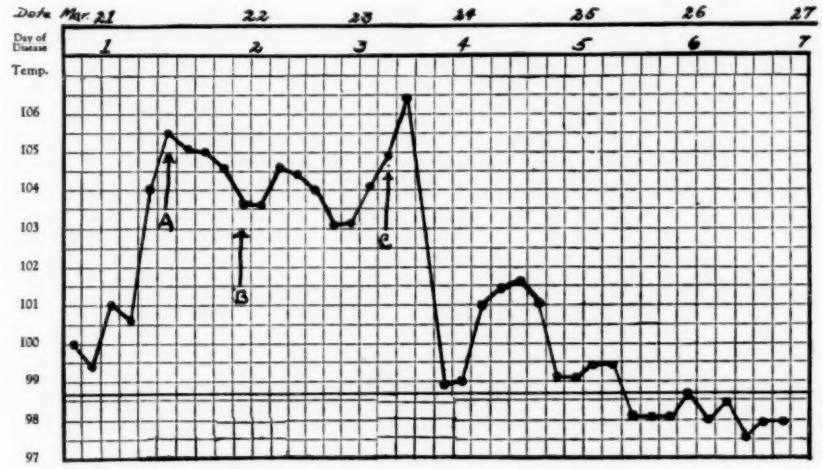

Chart 2.—Temperature of T. P. *A*, 40 mg. gentian violet was injected intravenously; *B*, 64 mg. gentian violet, intravenously; *C*, 110 cc. citrated whole blood, intravenously.

COMMENT

It is interesting to speculate on the rationale of the treatment of erysipelas by transfusion. It is sometimes maintained that this result, as well as the critical drop in scarlet fever following the injection of Dochez' or Dick's serum, is merely a manifestation of nonspecific protein shock. This explanation seems hardly tenable in face of the fact that two of our patients received very large doses of antistreptococcal serum, intraperitoneally, intramuscularly and intravenously, with no effect, whereas transfusion shortly afterward was followed in both cases by immediate defervescence. It seems much more probable that a varying degree of immunity to *Streptococcus erysipelatis* is acquired within the first few years of life as a result of infections of the upper respiratory tract in which this organism takes part. This hypothesis

would explain the almost uniform fatality of the infection at and shortly after birth, and the rapid decline of the mortality curve with advancing age. The fact that a certain small percentage of adults die of erysipelas should explain why adult serum from all donors is not equally efficacious. Kaiser's excellent result with erysipelas serum from convalescent patients speaks for this explanation. On this basis it can be readily understood why Robertson and Brown's results with exsanguination transfusion appear somewhat better than our results, without of necessity assuming some special virtue in the exsanguination, as these observers gave their patients considerably larger quantities of adult blood than we were able to give. Finally, an interesting similarity between the reaction of the

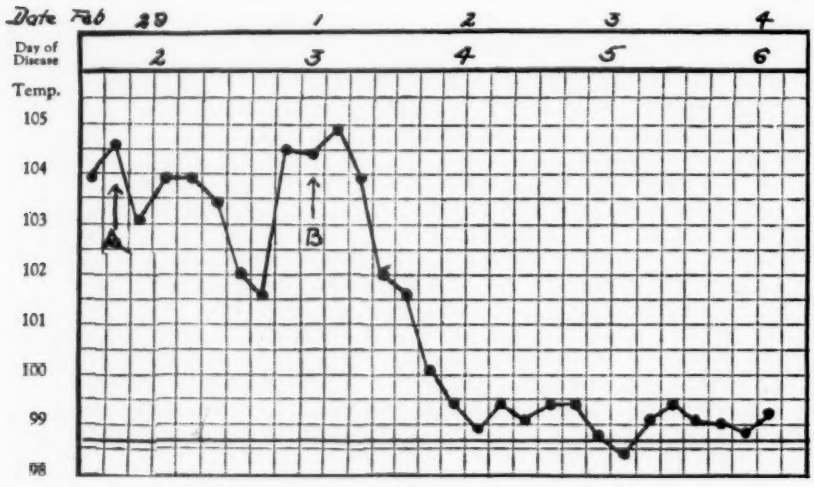

Chart 3.—Temperature of C. G. *A*, 65 cc. of intravenous whole citrated blood; *B*, 65 cc. intravenous citrated blood (different donor).

erysipelatous lesion to transfusion and that of the diphtheritic membrane to antitoxin should be mentioned. It has been consistently noted that in the successfully treated patients, the margin continues to spread for from twelve to twenty-four hours following the treatment, after which the whole lesion fades rapidly, just as the diphtheritic membrane continues to grow for the same length of time before it finally disappears. Serologic work is being done which may throw light on the problem in the near future.

SUMMARY

A series of 101 cases of erysipelas in infants and in children has been reported. Nineteen of these were treated by the intravenous transfusion of whole citrated blood. The mortality in the treated group is distinctly lower than that in the control group.

REPORT OF TYPICAL CASES

CASE 1.—D. R., a white girl, aged 2 months, had facial erysipelas which started two weeks before admission and gradually extended downward, involving the chest, abdomen and thighs. When first seen the lesions covered the buttocks, genitalia and right thigh, and were rapidly fading over the abdomen. Fifty cubic centimeters of antistreptococcus serum was administered intraperitoneally on admission and on the fourteenth day; 40 cc. was given intramuscularly on the morning following admission without any apparent effect. On the sixteenth day, 90 cc. of citrated whole blood was injected intravenously. The temperature dropped to normal within twenty-four hours and the rash quickly disappeared (chart 1).

CASE 2.—T. P., a white girl, aged 6 months, with erysipelas extending over most of the right leg, was admitted on the first day of disease. Forty milligrams of gentian violet was administered intravenously on the second day, and 64 mg. on the third day without any response. The area continued to spread. The intravenous injection of 110 cc. of whole citrated blood on the fourth day was followed by crisis and rapid recovery (chart 2).

CASE 3.—C. F., a white boy, aged 10 weeks, with erysipelas of the face and neck of two days' duration, was given an intravenous transfusion of 65 cc. of whole citrated blood on the day of admission, but showed no reaction. On the following day, transfusion was again performed, with the same amount of blood from another donor. The temperature dropped promptly to normal, and convalescence was uneventful (chart 3).

CORRECTION

In the article by Dr. M. Murray Peshkin, "Asthma in Children" (Am. J. Dis. Child. **32**:862 [Dec.] 1926), the word "eczema" at the beginning of the eighth line on page 864 should read "asthma."

PROGRESS IN PEDIATRICS

HELIOTHERAPY AND ACTINOTHERAPY IN RELATION TO PEDIATRICS

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I

(Continued from p. 921, December issue.)

RICKETS

Despite the fact that the ancients recognized that sunlight had a beneficial action on rickets as well as on a large number of other diseases, it appears that the year 1890 should be considered as the beginning of the modern application of light as a therapeutic measure for rickets. It was then that Palm reported his study on the geographic distribution and etiology of rickets, suggesting that sunlight should be considered a therapeutic agent. Buchholz (1904) used the "glühlicht" for treating sixteen cases of rickets. He attributed the beneficial action to the heat rays as well as to the light rays. Unfortunately, Buchholz's report never received the attention it should have had. Neumann (1909) noted that rickets occurred in a city located at an altitude of 1,560 meters, while in another at 1,740 meters where the children were allowed plenty of freedom and lived mostly outdoors, rickets was unknown. It was not known whether isolation, lowered barometric pressure, or avoidance of domestication was responsible for the difference in these cities. Raczysky (1912) furnished direct experimental evidence concerning the influence of light on the skeleton. He used two puppies suckled by their mother; one of them received plenty of sunlight, while the other was reared in absolute darkness. At the age of six weeks both puppies were killed and their bodies were analyzed for calcium oxide, phosphorus pentoxide, magnesium oxide, chlorine and iron. Raczysky found that the calcium oxide and phosphorus oxide, the compounds important in a study of rickets, were present in larger quantities in the body of the puppy which received plenty of light than in the body of the one kept in the dark. Judging from the calcium and phosphorus content, he assumed that the puppy reared without sunlight had rickets. He states: "It is the sun which plays the principal rôle in the etiology of rickets."

Winkler (1918) used roentgen rays for treating rickets and obtained favorable results. Ferguson (1918) did not observe any influence of light on the incidence of rickets in Glasgow.

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Huldschinsky (1919, 1920), Putzig (1920), Karger (1920), Riedel (1920), Mengert (1921), Erlacher (1921), Hess and Unger (1920-1921), Weber (1921), Meyer (1921) and Chick, Dalyell, Hume, Mackay and Smith (1922) used the ultraviolet rays of the mercury-vapor quartz lamp for the treatment of rickets. The number of exposures to the rays varied. Huldschinsky obtained cures after twenty-six exposures; Erlacher used from forty to sixty exposures. Not all of the early clinical cases were convincing. Most of the results were controlled by roentgen-ray pictures. Huldschinsky wrote:

> The therapeutic effect of quartz light irradiation is invariably apparent in all forms of rickets. Recovery results more promptly than with any of the methods employed heretofore. The effects of irradiation are lasting and the regenerative process is active for at least two months after interruption of the treatment.

Hess and Unger (1920) were not so enthusiastic about the therapeutic action of ultraviolet rays. In six patients with rickets treated with ultraviolet rays, these authors could not observe any beneficial effects. They conclude:

> Violet ray therapy cannot be considered the equivalent of heliotherapy. But the fact that rickets is exceptional in the arctic region, where there is a lack of sunlight for the greater part of the year, is a strong argument against its predominant influence. . . . It was found that rickets can develop notwithstanding an abundance of fresh air. It occurred in the larger and in the smaller rooms of the institution, and developed in infants at the tuberculosis preventorium, an institution in the country where particular attention is paid to outdoor treatment. It was found likewise that a liberal allowance of light could not prevent the development of this disorder. Infants in glass cubicles were not spared more than those in the regular wards.

A year later (1921), Hess and Unger retracted the foregoing conclusions. Further observations on the effects of ultraviolet rays and sunlight in the treatment of rickets convinced them that definite improvement could be obtained in rachitic children. Meyer (1921) considered ultraviolet light valuable in the prophylaxis of rickets. He states "Rickets is a folk disease of the present age." According to Meyer, every infant in Vienna and Berlin is rachitic. Weber (1921) reported phenomenal improvement in severe rickets by the treatment with the mercury-vapor quartz lamp. No improvement had been derived from phosphorus and oil therapy in his cases. Hess and Unger (1921) showed by roentgen ray that sunlight and the light of the mercury-vapor quartz lamp are equally effective in curing infantile rickets. Hess, Unger and Pappenheimer (1921) reported the antirachitic action of sunlight in cases of rickets in rats. Hess and Unger (1921) considered that the seasonal variation in the occurrence of rickets is due to a variation in the intensity of the sun's rays.

Powers, Park, Shipley, McCollum and Simmonds (1921) studied the action of sunlight on rickets in rats as follows: Two groups of

rats were fed a rickets-producing diet. One group was exposed to sunlight for about 242 hours at daily intervals. The other group was left under ordinary laboratory conditions. In the first group there was not a single case of rickets. The rats were active, had a good appearance, but were lighter in weight than normal animals. The group of animals on the deficient diet deprived of sunlight all developed rickets. Although the bones were completely calcified they were thinner than normal. The authors say:

> As the result of the gross and histologic examinations made on the rats fed the rickets-producing diet 3,143, but exposed to sunlight, it is possible to say that the changes produced by sunlight in the skeleton do not differ in any important respect from the changes produced when the animals are left in room light but on a diet supplemented by cod liver oil. Cod liver oil contains something which is essential for optimal cellular function. Light also contains something which is essential for optimal function. Cod liver oil or light, when made available to an organism previously deprived of either, permits the organism to put into successful operation adaptations or defense mechanisms which otherwise would have been ineffectual. Neither cod-liver oil nor light meets the defects in the composition of the diet directly by supplying to the body either calcium or phosphorus, but meets them indirectly by so raising the potential of cellular activity as to secure the most efficient utilization possible of those substances available in the body which are directly or indirectly concerned with ossification and calcification.

Powers, Park, Shipley, McCollum, and Simmonds (1921), irradiating rats with a mercury-vapor quartz lamp, found that the effect on growth and calcification of the skeleton was similar if not identical with the results produced by sunlight and cod liver oil.

Hess, Unger and Pappenheimer (1922) healed rachitic lesions which developed in rats fed on a diet adequate in calcium but deficient in phosphorus by short exposure to direct sunlight. The protection thus obtained is equivalent to that obtained by the addition of 75 mg. of basic potassium phosphate. Hess, Pappenheimer and Weinstock (1922) protected rats, which were fed a rickets-producing diet, against rickets by daily irradiation for two minutes by the mercury-vapor quartz lamp. By interposing standard glass filters, they determined that rays as long as 344 millimicrons have little or no protective action. The effective rays begin in the neighborhood of 313 millimicrons.

Hume (1922) studied the effect of irradiation with the mercury-vapor quartz lamp on the growth of rats fed on a diet deficient in vitamin A. She found that irradiation with the lamp prolonged the growth of rats on a diet free or almost free from vitamin A. Without irradiation, growth ceased to be normal after from seven to ten days; with irradiation it was normal for from thirty-five to fifty days. At that time or soon after, symptoms of vitamin A deficiency set in. Symptoms of vitamin deficiency could not be relieved by irradiation in animals which had been on a deficient diet over ninety days. Miss Hume concludes that there is an interaction of light and vitamin A in

the growth of rats, but no photosynthesis of the vitamin. The vitamin is economized or the vitamin stores are forced to yield it up at a rate sufficient to produce normal growth until they are wholly exhausted.

Goldblatt and Soames (1922) confirmed this. They learned that rats irradiated with the mercury-vapor quartz lamp grow at the normal rate for from four to five weeks after being placed on a diet deficient in the fat-soluble vitamin. Very slight or only temporary improvement is noted when rats which have ceased to grow as a result of fat-soluble, vitamin deficiency are irradiated. They consider: "Radiation is thus no substitute for the vitamin, but in some way economizes it in its action."

Sheets and Funk (1922) found that ultraviolet rays protect rats fed a diet deficient in vitamin A against rickets, but do not prevent the development of xerophthalmia. Powers, Park and Simmonds (1922) studied the influence of light and darkness on the development of xerophthalmia in the rat. The animals received a diet deficient in vitamin A and in phosphorus. They were divided into four groups, one of which was exposed to ultraviolet rays from a lamp; a second was kept in absolute darkness; a third remained under ordinary laboratory conditions, and the fourth was exposed to sunlight. The first three groups developed xerophthalmia and became emaciated. The fourth was protected against rickets and had delayed development of xerophthalmia.

Hess and Unger (1922) used the carbon arc light in the prevention and cure of rickets. Their treatment resulted in a rapid disappearance of the signs of rickets, accompanied by a constant increase in the inorganic phosphates of the blood. They could not cure rickets by addition of dipotassium hydrogen phosphate to the ordinary diet, but they believed that previous administration of phosphate hastened the cure by the carbon arc light.

Shipley (1922) exposed animals to the sun's rays or those from a cadmium, iron chromium, or mercury-vapor quartz lamp. Irradiation with these lamps improved the condition of animals receiving a diet with an inadequate calcium: phosphorus ratio. Analysis of the phosphorus and calcium of the blood showed the same characteristic changes as were obtained when cod liver oil was administered to the animals. Shipley found the shorter ultraviolet rays (210 millimicrons) had the greatest antirachitic effect. Kramer and Boone (1922) found that when children were cured of rickets by exposure to sunlight, the calcium and phosphorus content of the blood serum returned to normal. Kramer, Casparis and Howland (1922) observed that before treating rickets with quartz lamp therapy, the inorganic phosphorus content of the blood serum was from 2.7 to 3.2 mg. per hundred cubic centimeters. These figures gradually increased to a maximum of 7 mg. under treatment. Kramer and Howland (1922) found that exposure to irradiations

from various sources which yield, among others, rays whose wave length is less than 300 millimicrons, can be considered one of the factors which will control the concentration of calcium and inorganic phosphorus in blood serum of rats.

Tisdall (1922) exposed rachitic infants to ultraviolet rays from a mercury-vapor quartz lamp for short periods, and obtained a marked increase in both the calcium and inorganic content of the blood serum. This increase of these elements in the serum was followed by clinical and roentgenographic evidence of healing. Prolonged exposure to the rays from an ordinary 500 watt incandescent lamp did not increase the calcium or phosphorus of the blood.

Schultzer and Sonne (1923) have shown that irradiation with the mercury-vapor quartz lamp has a prophylactic action on experimental rickets. They exposed groups of rats receiving a rickets-producing diet to the rays of a quartz mercury-vapor lamp for periods varying from one to fifteen minutes daily. Each group of animals was thus protected from rickets. If all of the ultraviolet rays were cut out of the irradiation, rickets developed; however, if only the extreme ultraviolet rays were excluded by the use of filters, protection was obtained. The authors conclude that the active rays are ultraviolet rays situated between 400 and about 280 millimicrons.

A study of the effects of darkness on rats and of their daily irradiation with the mercury-vapor quartz lamp was made by Goldblatt and Soames (1923). Two litters of rats were given a normal diet containing adequate amounts of calcium, phosphorus and vitamin A. Cod liver oil supplied vitamin A to one group; butter fat was used for this purpose in the other group. One half of each litter was left in the dark; the other, in daylight, with the addition daily of a twenty minute irradiation under a mercury-vapor quartz lamp. No difference was found between the two groups histologically or in the calcium content of their bones.

Further observation by Goldblatt and Soames (1923) revealed the fact that rats on a diet deficient in the fat-soluble organic factor grow normally and show normal calcification of the bones, if they are irradiated for about ten minutes daily by a mercury-vapor lamp. If the fat-soluble factor is completely absent, the rats respond to light therapeusis, but never attain normal development.

Eckstein (1923) showed by experiments on rats that their growth, as measured by length and weight as well as development, is independent of the quality of natural light (red, blue, violet or gray), and of its intensity. These results are in accord with those of J. Loeb. Artificial ultraviolet light produced a retardation in the growth of these animals. Rats on a vitamin-free diet died sooner after ultraviolet irradiation than those not exposed to the rays.

Hess and Weinstock (1923), in a study of the relation of light waves to rickets, found that the spectrum contains curative rays for rickets, and other rays which neutralize or inhibit the effect of the antirachitic rays. By interposing glass filters they found that waves, in order to be beneficial for rickets, must not be longer than 302 to 313 millimicrons. Hess and Weinstock believe that the visible rays of infra-red inhibit the curative action of the ultraviolet rays.

Allenbach and Simon (1923) fed three groups (six each) of young rats as follows: (1) normal diet; (2) McCollum's diet 3,143, and (3) same as 2, but the animals were exposed daily to ultraviolet light. After an experimental period of forty-nine days, group 1 was much larger and heavier than either of the other groups. The animals of groups 2 and 3 were practically identical; they showed enlargement of the cartilage but no well defined bone deformation.

Vignard, Mouriquand, Chassard and Bernheim (1923) showed by roentgenography that ultraviolet ray treatment, in cases of rachitic children, caused precipitation of calcium at the junction of bone and cartilage. Orr, Holt, Wilkins and Boone (1923) carried out a series of metabolic studies on rachitic infants. These infants failed to retain calcium and phosphorus, although there was a sufficient amount in the diet. Under ultraviolet therapy the retention of these elements and the amounts of calcium and phosphorus found in the urine are increased, indicating an increased absorption from the intestine. They argue that defective absorption from the intestine in active rickets is the cause of the low calcium and phosphorus found in the blood serum. This is, then, the ultimate cause of the defective calcification of the bones.

Lesné, de Gennes, and Guillaumin considered the variations of calcium utilization in rickets under the action of light. The mean calcium content of normal infants from 2 months to 2 years of age is from 100 to 120 mg. per liter of blood serum. Twenty infants with rickets had a calcium content from 79 to 104 mg. (average, 92 mg.). Two children, aged 3 and 8 years, with irreducible rachitic deformations had a slightly higher calcium figure than normal; namely, 118 and 114 mg., respectively. The administration of calcium or changes in temperature did not alter the calcium content of the blood serum. Ten infants were irradiated daily for thirty minutes by a 1,200 candle power arc lamp at a distance of 1.2 meters. The ultraviolet rays alone were beneficial. Eight irradiations increased the serum calcium in seven cases; twenty-four brought it to the normal figure in eight cases. The two subjects who showed no increase in the calcium content were dark skinned. Ultraviolet irradiation of infants relieves the rachitic conditions, which are apparently due to a deficiency of phosphorus and an inability to fix calcium. Diminished calcium in the blood serum is not the cause of rickets. Kneschke (1923) confirmed the results of Mayer,

György, Kramer and Lesné and co-workers. All of these investigators obtain an increase in the calcium content of the blood by irradiation of rachitic children.

Steenbock and Nelson (1923) restored growth in rats, maintained on a diet with no fat-soluble vitamin, by aerated cod liver oil and ultraviolet light. These agents are antirachitic but not antixerophthalmic. This evidence supports the view that cod liver oil contains two vitamins; namely, A and D.

Hart, Steenbock, Lepkovsky and Halpin (1923) worked on the nutritional requirements of baby chicks, with special consideration of the relation of light to growth of the chicken. The chickens were fed a ration which has invariably led to cessation of growth and symptoms of rickets or leg weakness. Five groups of chickens were studied: group 1 was kept in a dimly lighted basement; group 2 had all day access to sunlight; groups 3 and 4 received ten and sixty minutes', respectively, exposure to sunlight; group 5 was irradiated daily for ten minutes by a mercury-vapor quartz lamp. The chicks which were kept without sunlight died in six weeks. At that time they weighed approximately 100 Gm. Group 2 obtained an average weight of about 250 Gm. in eight weeks. Group 3 was similar to group 1. Groups 4 and 5 grew better and lived longer than the chickens in group 1 and 2, but they were not equal as a group to the one which received all day sunlight (group 2). Hart and his co-workers think "that light can play an important part in the raising of baby chicks, acting as a supplement or the equivalent to the antirachitic factor of foodstuffs." It appeared that thirty minutes daily exposure to direct sunlight is more potent than fresh green clover as an antirachitic agent.

Similar results were obtained by Bovie (1925) at the University of Maine. He states:

> Since in these experiments the chickens grew and developed normally in full sunlight, and since they did not grow and develop in a normal manner in light transmitted by glass, it is evident that chickens, at least, are vitally dependent on this narrow band of the ultraviolet.

Fisher (1923) made a study of clinical rickets. After the diet was regulated, the children were divided into groups as follows: (1) those treated with sunlight; (2) those treated with cod liver oil; (3) those treated with an active concentrate prepared from cod liver oil. "As a result of our investigation, we believe that in the management of rickets every known therapeutic agent should be made use of. The best results are obtained under a treatment combining proper food, cod liver oil and exposure to sunlight." Cod liver oil is recommended as a prophylactic, as well as a curative, measure. Armand-Delille (1923) considers sunlight the best preventive and curative measure for rickets. Its suppression or absence seems to be the chief factor and most impor-

tant in modifying the phosphorus and calcium metabolism of the rachitic infant. Chick and her co-workers (1923), who conducted an extensive study in Vienna, concluded that irradiation by a mercury-vapor quartz lamp is as beneficial in curing rickets as the antirachitic foods.

From an analysis of the reports just considered, it is proved that rickets in children and experimental animals can be cured by irradiation with lamps which contain the short ultraviolet rays. Exposure to these rays also promotes growth in animals fed a diet deficient in the antirachitic vitamin. These considerations naturally led investigators to believe that there was a connection between the vitamins and the effects of ultraviolet irradiation.

Attempts to discover a relation between the vitamin and ultraviolet irradiation have produced considerable interesting research, some of which has been disproved, and the problem still remains unsolved.

Hume and Smith (1923) thought that irradiated air was responsible for the growth of rats fed on a diet deficient in fat-soluble vitamins. They fed a fat-soluble diet deficient in vitamins to rats kept in glass jars which had been exposed to the mercury-vapor quartz lamp for ten minutes every second day. Rats kept under these conditions showed prolongation of normal growth over control rats kept in jars containing unirradiated air. Rats kept in an atmosphere of air containing ozone drawn over the quartz lamps and passed through 3 meters of glass tubing, 0.8 cm. bore, showed poorer growth than the control animals. They conclude that "it is the air and not some property impressed on the glass jars which is active." They suggest ionization of air as a cause. Webster and Hill (1923) obtained results contrary to Hume and Smith. The growth of rats on a diet deficient in vitamin A could not be stimulated by irradiation from a mercury-vapor quartz lamp of the air in which the animal lived. Ozone, dilute nitrogen peroxide gas, air exposed to roentgen rays and to cigaret smoke were also tried, but did not augment growth. Exposure of the rats to air led from the enclosure of the mercury-vapor lamp for half an hour daily had no effect on the prognosis of rickets in rats receiving a diet deficient in vitamin. Chick and Tazelaar showed that the effect observed by Hume and Smith could not be attributed to ionization of the air, but was due to the irradiation of sawdust used for bedding which the animals ate. When Hume and Smith (1924) repeated their experiments, they found that the growth promoting and antirachitic properties which the animals received resided in the sawdust. Similar conclusions were made by Nelson and Steenbock (1925). Hughes, Nitcher and Titus (1925), studying the relative value of ultraviolet light and irradiated air in preventing rickets in chickens, concluded that the fowl must be exposed to the direct rays of the lamp in order to be cured. Irradiated air has no therapeutic value in treating rickets in chickens.

The question of whether irradiated animals had a beneficial effect when placed in the same cage with nonirradiated animals has also received considerable attention. Nelson and Steenbock (1925) have definitely proved the fallacy of this assumption. They obtained no evidence that irradiated rats give off radiations capable of exerting an antirachitic effect on their neighbors. However, evidence was obtained that the antirachitic action of irradiated animals placed in the same cage with nonirradiated animals is effected by the consumption of traces of excreta. This indicates that an irradiated animal has bodily constituents which are made antirachitic.

During the controversy over air and the fact that the animals themselves might become radioactive, Steenbock and Black (1924) discovered and patented a process for inducing antirachitic properties in a ration by exposing it to radiation from a mercury-vapor quartz lamp. The ration is activated to the same degree as when rats are irradiated directly. This activation occurs when the ration is irradiated in an open dish, in a stoppered pyrex or quartz flask filled with air or carbon dioxide, but not in a brown bottle. The activation is not destroyed by subjecting the ration to a vacuum, heating it for forty-five minutes at 96 degrees, or letting it stand for a day at room temperature. Steenbock and Black confirmed the observations of Goldblatt and Soames (1923) that livers taken from irradiated rats are growth-promoting, while liver from nonirradiated rats is inactive. The same was found true of lung and muscle tissue. Inactive muscle became active if irradiated after removal from the body. Liver thus treated was antirachitic. The activity of liver taken from irradiated rats was not destroyed by drying at 96 degrees for twenty-four hours and then keeping it in a stoppered bottle in the laboratory for two months. "The question now presents itself, Are we justified in making the further assumption, in view of the fact that growth-promoting and calcium-depositing properties can be imparted to a ration by irradiation with ultraviolet light, that the acceptance of the existence of an antirachitic vitamin on its former premises is no longer justifiable, granted, of course, that we accept a vitamin as a compound of biological origin?"

As soon as Steenbock and Black announced their discovery, many other investigators started similar research and added interesting contributions. Steenbock and Nelson (1924) found that rats, fed a rickets-producing ration which had been irradiated, were definitely protected against rickets. Histologic data are given to prove their conclusions.

Hess and Weinstock (1924) endowed various inert fluids and green vegetables with antirachitic properties by irradiation with the mercury-vapor quartz lamp. It was found that cottonseed oil and linseed oil could be rendered specifically active by this means. After irradiation these oils protected rats from rickets when the animals received 0.1 cc.

of the oil daily, incorporated in the rickets-producing diet. The irradiated oils were able to store this factor for a considerable period. Wheat which was grown in the dark had no antirachitic properties, but grown in the light and irradiated conferred protection when fed to rats. The same differences in regard to antirachitic properties were observed in vegetables which were irradiated after they had been picked. Green lettuce leaves from the market were of no value in preventing rickets; after irradiation they were potent. In the picked as well as in the growing green vegetables, light treatment led to the formation of an antirachitic factor. Hess and Weinstock had produced an antirachitic factor in vitro and in the growing plant. Spinka (1924) found that irradiated butter still possesses its vitamin A activity. When butter is irradiated in air, toxic substances are produced which cause death to animals when it is incorporated in the diet. Vitamin B in neutral or weakly acid solutions is not destroyed by ultraviolet light. Vitamin D is resistant to irradiation.

Luce (1924) concluded that the diet of a cow is the principal factor determining the growth promoting and antirachitic value of her milk. Further experimentation (1924) was carried on as follows: A cow was kept for eight months on a diet deficient in fat-soluble vitamins and a comparison of the value of the milk, given when in a stall under winter conditions and when exposed to sunlight of summer intensity, was made. The milk was fed to rats to test its properties. Luce concludes that the observations here reported show that sunlight of summer intensity in England has no significant effect in raising the growth-promoting value of cow's milk, when the diet of the animal is deficient in fat-soluble vitamins. The degree of exposure to sunlight appears to have a small effect in determining the antirachitic value of the milk given.

Boas and Chick (1924) considered the influence of diet and management of the cow on the calcification of rats' bones. The rats received milk in their daily diet. They state that the diet of the cow and the amount of sunlight which she receives influences the potency of the milk in producing calcification. To determine the influence of sunlight on growth, Steenbock, Hart and Jones (1924) conducted experiments on young pigs which had not had the opportunity to store much of the antirachitic vitamin. From chemical analysis of the blood and bones and a histologic study of the bones, they believed that sunlight was a factor of economic importance in the production of pork under confined conditions in northern latitudes.

Steenbock and Daniels (1925), considering the therapeutic possibilities of irradiated foods and irradiated organic compounds, conclude:

> By exposing such food materials as wheat, rolled oats, corn, hominy, cream of wheat, shredded wheat biscuits, corn flakes, patent wheat flour, cornstarch, meat, milk and egg yolk to ultraviolet light, they can be endowed with rickets-

preventing properties. That such a wide variety of foods can be thus affected appears to be due to the fact that practically all natural occurring foods contain lipoidal constituents of the nature of sterols which can carry this activation. Cholesterol, for example, as obtained from brain is entirely inactive, but after exposure to ultraviolet light becomes rickets preventing.

Drummond, Rosenheim and Coward (1925) reported experiments on the same subject. Hess, Weinstock and Helman (1925) state that non-irradiated phytosterol and cholesterol are not protective against rickets, but after they are irradiated prevent the development of rickets. Hess and Weinstock (1925) found that antirachitic properties can be conferred by irradiation on etiolated yellow wheat as well as green wheat and lettuce. A solution of chlorophyll is not endowed with antirachitic power by irradiation, nor are hemoglobin, red blood cells, cream, the phosphatid of yolk of egg or glycerol. The protective action of vegetable oils can be obtained equally well by irradiation in an atmosphere of nitrogen, so that oxygen plays no rôle in the process. Fractionization showed that the active principle is present only in the nonsaponifiable fraction of the irradiated oils.

Hess and Weinstock (1925) found that irradiated cholesterol protects when given subcutaneously instead of per os. A series of tests with selective filters showed that the irradiations which render cholesterol biologically active are similar in their wave lengths to those which have been found to protect animals against rickets when they are directly exposed to the rays. Skin which does not possess antirachitic properties acquires it by irradiation.

Steenbock and Black (1925) presented in considerable detail evidence of the activation of fats. They based their conclusions on increased calcium content of the bone, the McCollum line test, and continued growth. Excessive irradiation of olive and cod liver oils makes them inactive. The antirachitic potency of irradiated fats resides in the unsaponifiable fraction. Mineral oil cannot be activated. Old oils, acid in reaction, could not be activated. Kramer (1925) treated rickets in infants with irradiated milk which induced a marked retention of both calcium and phosphorus.

When it was shown that rations could be activated by ultraviolet irradiation so that they became growth-promoting and antirachitic, the question was immediately raised as to how the activated foodstuffs exerted their physiologic action.

Kugelmass and McQuarrie (1924) presented one theory, which was fascinating for a time. They claimed that activated materials emitted secondary radiations which produced the curative action. Their data showed that antirachitic substances, such as cod liver oil, on oxidation emit radiations which are capable of blackening sensitive photographic plates when passed through quartz but not through glass screens. The conclusion was drawn that ultraviolet rays were produced, and that the

degree of blackening is a function of the rate of oxidation. They tested cod liver oil, the unsaponifiable fraction of cod liver oil, oxidized cod liver oil, egg yolk, bile, hydroquinol, and sperm oil, all antirachitic substances; also the following, which are not curative of rickets, namely, linseed oil, cottonseed oil, peanut oil, lard, the saponifiable fraction of cod liver oil, liquid petrolatum and glycerin, and which do not affect a photographic plate. Their experimental data showed that the oxidized substances curative of rickets, when exposed to ultraviolet radiation, liberate oxygen. Therefore the photochemical reaction appears to be reversible and may be expressed: oxygen + rickets-curing substances ⇄ oxy-substances + ultraviolet rays.

MacCullum (1924) found that the vapor arising from cod liver oil will produce a picture on a photographic plate exposed to it in the dark if the plate is protected by a pattern. He considers this is due to direct chemical action of the vapor on the plate and not to irradiation, as he obtained no picture when a quartz plate was interposed.

Schlutz and Morse (1925) repeated the work of Kugelmass and McQuarrie, and in every case obtained negative results. They made spectroscopic observations on cod liver oil, and suggested that the disappearance of bands in the absorption spectrum of cholesterol may be used as an index of its antirachitic activity, perhaps eliminating to some degree the necessity for rat experiments.

Drummond and Coward (1925), Drummond and Webster (1925), and West and Bishop (1925) also showed that the experiments on which Kugelmass and McQuarrie based their opinion were faulty. Kugelmass and McQuarrié (1925) admitted their error and ascribed the action on the plate to the "Russell effect."

Hess (1924) attempted to prevent rickets in rats by using fluids which contained radium, but he was not successful. Langworthy (1924) reported that ripe tomatoes possess radioactivity. This property decreases as the fruit ripens.

There is an abundance of research which supports another theory concerning the mechanism of activation of the foodstuffs. The second theory contends that active substances are produced from inactive ones by the action of ultraviolet radiations. Hess and Weinstock (1925) showed that irradiation of cholesterol at first increased the amount of transmitted light, but this effect is reversed on prolonged treatment. This change in the spectrographic picture produced by irradiation runs parallel with the antirachitic activity. Cholesterol and phytosterol undergo marked chemical changes on irradiation. They are converted into yellow, waxy compounds, with melting points which are much lower than those of the original compounds. Changes of a similar kind in sterols were reported by Schulze and Winterstein (1904), and by Roffo (1924).

Rosenheim and Webster (1925) have shown that the antirachitic factor is formed from cholesterol by irradiation in the presence and absence of oxygen. They show by rat experiments that ultraviolet light produces the vitamin D and not vitamin A when cholesterol is irradiated. Hess, Weinstock and Sherman (1926), attempting to discover the nature of the activated substance, have made a chemical and biologic study of the change which occurs on radiation. Purified cholesterol and anhydrous cholesterol are activated by irradiation. This is evidence that the sterol is made antirachitic. Cholesterol acetate becomes antirachitic on irradiation, which is additional evidence that the double bond plays a rôle in the activation. Irradiated cholesterol has greater power to inhibit the hemolytic action of digitonin than unirradiated cholesterol. Koch, Cahan and Gustavson (1926) have extracted from irradiated cholesterol with liquid ammonia a small amount of brown resinous material which augments the growth of rats. A similar substance was obtained by extracting the unsaponifiable fraction of cod liver oil with ammonia. Although the nature of the active compound is as yet unknown, it appears that it will soon be known, since we now have methods of preparing it easily and in a pure form.

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Abstracts from Current Literature

Pathology, Bacteriology and Biochemistry

Comparison of the Potency, Polyvalency and Therapeutic Action of Antimeningococcus Serums. Augustus Wadsworth and Mary B. Kirkbride, Am. J. Hyg. **6**:507, 1926.

The agglutination test is considered the best method of standardizing antimeningococcus serums, especially in conjunction with the use of standard cultures of the recognized groups with standard serum for comparison. Antiserums from horses immunized with six selected strains apparently have higher titer and polyvalency than serums produced with four, twenty or sixty strains. High agglutinative activity of a serum seems in no way associated with a lack of therapeutic potency or of polyvalency, but failure of agglutination, especially with some strains, doses not indicate absence of therapeutic value for the serum. In the therapeutic use of antiserums in 129 cases, a few patients reacted favorably at first but then succumbed to complicating developments. A few failed to respond at all, but on the whole, the mortality was low, and the importance of early diagnosis and prompt treatment was confirmed.

Ethel B. Perry.

The Hypersensitiveness Following Injections of Placental Extracts. G. H. Smith and L. K. Musselman, J. Immunol. **12**:7, 1926.

From the author's experiments the following conclusions are made:

Animals passively sensitized by the intraperitoneal injection of 2 cc. of the antiserum presented severe anaphylactic shock, and in one case died, when female human serum was injected forty-eight hours after the sensitizing treatment. Male serum administered under comparable conditions elicited no reaction. Guinea-pigs actively sensitized with extracts of human placenta present a marked hypersensitivity to human serums. Such animals manifest acute anaphylactic shock on the subsequent intravenous injection of either male or female human serums and a definite reaction to the reinjection of placental extract. This would indicate that the amount of serum present in the placental extract is small, although ample to induce a serum sensitivity. Guinea-pigs sensitized with placental extracts may be desensitized to human serum, or at least to male human serum by intraperitoneal injections of male human serum. Such desensitized animals may still be acutely intoxicated by female human serum in doses which are inactive if administered to normal guinea-pigs. Comparable quantities of male human serums fail to induce acute fatal shock, or if shock occurs it is much less intense than that caused by female serum. Guinea-pigs which have reacted to male human serum with acute but not fatal shock may die of acute anaphylactic shock if given subsequent reinjections intravenously with female human serum. Guinea-pigs passively sensitized with the serums of rabbits which have received a series of injections of placental extract are hypersensitive to female human serum while sensitivity to male human serum is lacking. These differences in the intoxicating effects of male and female human serums appear to be determined by qualitative factors, suggesting a common antigenic relationship between some fraction of the material of the placental extract and female human serum.

S. A. Levinson.

CONCERNING THE REPUTED PHOTO-ACTIVITY OF IRRADIATED SUBSTANCES. OTTO BECK, Monatschr. f. Kinderh. **33**:320, 1926.

In this series of interesting experiments, the author first determined which substances though originally inactive would become active after irradiation with a mercury vapor lamp. His method of determination was by the use of photographic plates. First he tested the substances before exposure to the light and after this control subjected them to the rays. In this way he found cod liver oil, olive oil, linseed oil, triolein, tripalmitin, tristearin, blood, milk, glycerin, liquid petrolatum and finally rat liver would become activated, while water, sugar, and starch remained inert.

It is known that lamps which do not provide rays rich in ultraviolet are not as active against rickets as the popular variety. But to his surprise the author found that these lamps could activate his test material. However, by a careful series of experiments, using screens that filtered out the various types of rays, he showed that the activation of his material was due to the small amount of ultraviolet rays generated by these lamps and not to any other type of ray.

Some of the substances activated by ultraviolet irradiation to darken a photographic plate are not clinically active against rickets. Is there, then, some other factor which has not been recognized?

The next experiments were concerned with the effect of irradiation on the spectra of the various activated materials. Here a difference became manifest. In a like manner investigations on the iodine quotient showed decided changes. The physiologically active drugs showed a lengthening of the absorption spectrum and a decrease in the iodine factor. The physiologically inactive bodies showed shortening of the absorption spectrum and no change in the iodine factor.

The observations prove that the photographic plate is not a reliable test to prove whether a substance activated by irradiation is actively antirachitic, and they also show that ultraviolet rays produce some change in the irradiated bodies independent of the mere absorption of the rays.

URINE-PEPTIDASE AFTER IRRADIATION. EDMUND DREBBER, Monatschr. f. Kinderh. **33**:412, 1926.

The author attempted to learn whether exposure of a child to the quartz lamp affected the peptidase content of the urine and whether such change ran parallel to any change in the serum. In nine of ten children, he found a diminution in his peptidase index. In one there was no apparent change. The curve reached its lowest point in two hours and twenty minutes and proved to be parallel to the serum change. Further studies must depend on an increase in the knowledge as to the effect of light treatment on the kidneys.

GERSTLEY, Chicago.

APPLICATION OF THE KOTTMANN REACTION IN THE STUDY OF MILK AND SPINAL FLUID. K. OKAJIMA, J. Pediat. (Tokyo) May 20, 1926, p. 121.

The author tried the Kottmann reaction with permanent human milk, the colostrum and cow's milk and noted that there was both a qualitative and quantitative difference between them which may be employed as a means of differentiation. There was also a discoloration of the test fluid when it was applied to the spinal fluid obtained from cases of cerebral edema, tuberculous meningitis, epidemic cerebrospinal meningitis, Heine-Medin's disease, Wilson's disease and enterocolitis. The reaction may be applied to other conditions.

KATO, Los Angeles.

Nutrition

IRRADIATED ORANGE JUICE: ITS VALUE AS AN ANTIRACHITIC AGENT. HERMAN L. MASLOW, DAVID H. SHELLING and BENJAMIN KRAMER, Bull. Johns Hopkins Hosp. **39**:56, 1926.

When rachitic animals are fed irradiated orange juice, healing may occur after five days and is almost complete at the end of fifteen days. Those fed on nonirradiated orange juice showed either no healing or only small deposits of calcium salts in places about the cartilage cells, but none in the metaphysis.

In the majority of the animals, the inorganic phosphorus of the serum was higher in those receiving irradiated orange juice than in the controls.

Further work is to be done to ascertain the value of irradiated orange juice in the cure of rickets in children.

LYTTLE, New York.

MALNUTRITION IN INFANCY. H. BROOKS MILLS and SAMUEL GOLDBERG, M. J. & Rec. **124**:220 (Aug. 6) 1926.

The etiology of malnutrition is considered by the authors under three primary causes: (1) food; (2) infection and (3) constitutional anomalies or weakness.

1. Because of the modern modes of living, breast feeding is becoming rare, so that most of the infants suffering from malnutrition are artificially fed. Overfeeding in quantity, quality and frequency has probably been the most common cause. The results of giving excess of fat, carbohydrate and protein are discussed.

2. Infection may be either enteral or parenteral.

3. Constitutional defects are enumerated. Exudative diathesis is one type of constitutional disturbance, while another class of cases is of neuropathic origin.

In the treatment, conservation of human milk is emphasized. When the human milk is insufficient, complemental rather than supplemental feeding should be instituted. Special treatment for the various types of malnutrition is given.

NONRELATION OF MALNUTRITION IN SCHOOL CHILDREN TO INFECTION. H. W. HILL and ELIZABETH BREEZE, Canad. M. A. J. **16**:1086, 1926.

This excellent article is an abstract of the complete report published in *Canadian Public Health*, September, 1926.

To ascertain the relation of malnutrition to the incidence of infection, the records of about 8,000 school children in Vancouver were studied. The standards of Thomas D. Wood of Columbia University, New York, and also the more recent standards of Drs. Thomas D. Wood and Bird Baldwin were used for classifying the children as well nourished or malnourished. Tables are given showing the incidence of infections in the two groups.

The conclusion is reached that there is no evidence of any relation between malnutrition and the incidence of infection, each group, well nourished and malnourished, showing practically identical incidence to infection. The tables given consider only the acute infectious diseases: scarlet fever, diphtheria, measles, whooping cough, mumps, chickenpox and smallpox. The authors state that malnutrition and fatigue seem to be more important factors in acute and chronic respiratory infections, but they do not believe that even in these cases the relation to the incidence of these diseases is as important as is usually thought.

MOORE, Omaha.

THE TECHNIC OF BREAST FEEDING. AMY HODGSON, Practitioner **117**:98 (Aug.) 1926.

The successful management of breast feeding, when mother and child are healthy, depends mainly on two factors: (1) the mother's attitude toward the infant and the object in question; (2) the regular stimulation of the mother's breasts in the act of feeding.

The establishment of breast feeding must be begun in the antenatal period. The details of personal hygiene and of diet are important. Plenty of fluid and vegetables should be taken. A daily walk, normal exercise and at least eight hours of sleep and rest in the afternoon are important. Worry and anxiety should be avoided as much as possible.

The breasts should be cared for regularly by bathing and gentle massage. The nipples should be manipulated and tight clothing should be avoided.

Feeding of the infant should be regular, at three or four hour intervals. The mother's rest is of great importance, and the child should not be allowed to nurse irregularly. Nursing from both breasts is of value at the beginning until the milk supply is well established. At first the mother nurses the infant while lying down, but as soon as it is possible it is wiser to sit up for the nursing. If by any chance the infant is too feeble to suckle actively, the milk should be pumped or expressed from the breasts and given to the baby from a bottle or from a pipet.

In the maintenance of breast feeding, details again are important. It often happens, when the mother first gets up, that the milk disappears owing to a number of factors, such as increased housework, mental worry and overfatigue.

Often it has been found that when the milk does not agree with the child, it is really a question of overfeeding. Frequently, the quantity rather than the quality of milk is at fault. In restoring the milk supply which is waning, it is wise to pay particular attention to the mother's hygiene and diet and to increase her fluid intake; the diet must be carefully watched, however, so that the mother is not upset by many rich fluids. Galactogogues exert their effect largely psychologically.

It is of value at times to bathe the breasts several times a day with alternate hot and cold water. Massage of the breast must be expertly performed; otherwise it is dangerous. The baby must feed regularly, and complete emptying is essential. It is wiser to give complementary feedings rather than bottles at odd times.

GELSTON, San Francisco.

PIGMENTATION OF THE AREOLA OF THE BREAST. P. CHATIN, Nourrisson **13**:36 (Jan.) 1926.

Pigmentation of the areola of the breast is so common in pregnancy as to be considered one of the presumptive signs. It occurs with pigmentations elsewhere in the skin and mucous membranes. Cracks and fissures in the nipples are frequently associated with abnormal types of nipples which require prolonged nursing periods, leading to trauma and maceration. But the author has noted that fissures are much less likely to develop when the areola of the breast is deeply pigmented. Reasoning from this, he decided to use the ultraviolet rays in treating cracked nipples. The results have been favorable.

TREATMENT OF DIARRHEA IN BREAST-FED BABIES. LYDIA BYTSCH, Nourrisson **13**:40 (Jan.) 1926.

Diarrhea in breast-fed infants is often hard to overcome. The weight curve remains stationary or many even decline; the babies cry a great deal, lose their appetites and not infrequently are weaned at an early age. Madame Bytsch recommends the following: Slices of bread are toasted and then pulverized; of this two coffee spoonfuls are boiled with 100 cc. of weak tea and then sweetened with a little sugar or saccharin; two small spoonfuls of this modified tea are given before each nursing. The advantage of this treatment is that the baby is not weaned from the breast, and it prevents the development of toxic diarrhea, which so often follows the giving of modified cow's milk.

McCLELLAND, Cleveland.

AN INTERNATIONAL AGREEMENT ON METHODS OF FEEDING IN INFANCY. CZERNY, Rev. internat. de l'enf. **1**:487 (June) 1926.

Czerny calls attention to the confusion that must exist in the mind of the student who compares the various methods of feeding in different countries and even in the same country. He cites his own experiences and the changes that have marked the passage of the last few decades. Experts differ so widely in their opinions on this important matter that there seems to be almost as many methods as there are clinicians. He properly pleads for an international understanding, basing the conclusions on exact statistics from the various systems followed.

AMESSE, Denver.

AMMONIA IN THE STOOLS OF INFANTS. ANNIBALE PICCIOLI DOTT, Riv. di clin. pediat. **24**:530, 1926.

The author made 150 determinations of the ammonia content of the stools of five artificially fed infants under various conditions of diet. When the feeding consisted of a formula containing milk, water and sugar, the ammonia content of the fresh stool was from 0.08 to 0.12 per cent; when the diet was changed to whole milk, the ammonia in the stools increased from 0.15 to 0.20 per cent; additions of white or yolk of egg to milk formula did not permanently affect the percentage of ammonia. Constipation tended to increase the ammonia of the stools. As the ammonia in the stools rose, the infants semed to show less gain in weight.

HIGGINS, Cincinnati.

EXPERIENCES WITH SKIMMED BREAST MILK IN INFANTS WHO PASSED DECOMPOSED STOOLS. PAUL DORHOLT, Monatschr. f. Kinderh. **32**:366, 1926.

Because four infants who passed decomposed stools recovered on a diet of skimmed breast milk, the author believes that this is an argument in favor of the view that fat intolerance is the etiologic factor in producing the syndrome.

THE USE OF SKIMMED SOUR MILK IN INFANCY. A. POPOWA, Monatschr. f. Kinderh. **32**:521, 1926.

This is a review of the subject of buttermilk, and reports of the good results following its use not only in nutritional disturbance but also in the feeding of normal babies. The author varies the technic of its preparation slightly, in that he adds a few cubic centimeters of a 0.3 per cent soda solution to reduce the acidity about 2 per cent. Then sugar and flour are added. Only two of 236

children did not take the mixture well. This preparation is not adapted to children over 6 months of age; in these, its use seems to lower the immunity. Results with this mixture are better in a general way than with the preparations of Czerny and Biedert.

THE EFFECT OF MUSIC ON THE EFFICIENCY OF THE HUMAN BREAST. NEBERT and E. W. KOCH, Monatschr. f. Kinderh. **33**:385, 1926.

These studies were stimulated by a number of observations reported by workers in agricultural and dairy interests. The reports first showed that the amount of milk obtained from a cow at a milking is greater than the capacity of the mammary gland. Secretion is thus divided into two phases: one, a gradual secretion during the intervals between milking and the other, an active phase during milking, when secretion of milk proceeds rapidly.

In dairy circles, there is a tradition that is well established: cows give more milk when the cowherds and maids sing, and indeed some cows will give milk only when they hear a certain song. The authors quote von Statten-Aystetten who performed the experiment of giving concerts for the cattle in their stalls. He found them susceptible to the gramophone and the violin but noncooperative to trumpets. On days when the cattle heard music the milk was increased in amount by about 6 per cent. The percentage of solids was diminished, but the total solid was more than on the days when there was no music.

The authors attempted to apply these observations to the wet nurses in their institution. The wet nurses were placed in quiet surroundings and on certain days were permitted to listen to the gramophone playing such pleasant airs as Handel's "Largo" and "Tales of Hoffman." During the actual nursing, lively airs and marches were played.

The results showed an increase in milk secretion during the entire experimental period; i. e., on the days when there was no music as well as on the days when there was music. This is explained by the rest and pleasant environment. As soon as the nurses were removed to their own quarters, the milk supply diminished. The authors intend to try these experiments on women whose milk supply is failing. In wet nurses, the supply must be good or they would not be taken into the hospital. Perhaps the experiment might be effective in women with barely enough milk.

The reviewer believes the dairy experiments described above might be used in both a scientific and a practical way. For instance, one might broadcast a Saturday night symphony to some of the larger dairies in order to determine whether Beethoven, Bach or Mendelssohn had the most beneficial effect. One might also broadcast in the dairies the music of a modern jazz band and perhaps produce a spontaneously formed lactic acid milk.

THE TREATMENT OF RUMINATION WITH SIEGERT'S BALLOON. E. MOMMER, Monatschr. f. Kinderh. **33**:395, 1926.

Mommer reports a case of rumination in an extremely emaciated infant. As a last resort, the author tried a form of treatment recommended by Siegert; namely, the introduction of a tiny balloon into the esophagus after each meal. The effect was astonishing. The child started to gain at once. After a week the treatment was stopped. In a few days symptoms returned, but after another week of treatment rumination stopped, and the child was permanently cured.

AN ELECTRIC MILK PUMP. K. SCHEER, Monatschr. f. Kinderh. **33**:433, 1926.

Scheer describes an electrically driven breast pump, and claims that it is much simpler and infinitely less expensive than the present one on the market.

GERSTLEY, Chicago.

GASTRIC JUICE OF NORMAL INFANTS. S. SASAURA. J. Pediat. (Tokyo), September, 1925, p. 204.

The author studied the nature of the gastric juice of thirty-nine infants between the ages of 4 and 11 months. His summary is as follows: 1. The total acidity, free hydrochloric acid and hydrogen ion concentration of gastric juice increase with the time that passes after nursing. 2. The total acidity does not necessarily increase with free hydrochloric acid and hydrogen ion concentration. 3. The total acidity varies from 0.146 to 1.77025 per thousand during the hour immediately following nursing. 4. Free hydrochloric acid appears earlier and in larger amount if the amount of milk taken is smaller. 5. It appears earlier and in larger amount in Japanese infants than in European infants. 6. Hydrogen ion concentration is also greater in Japanese infants. 7. Great variation in total acidity, free hydrochloric acid and hydrogen ion concentration may be remedied by fixing the amount of milk to be nursed. 8. Free hydrochloric acid and hydrogen ion concentration reach their highest mark at from 7 to 8 months, decreasing somewhat thereafter.

STUDIES OF THE PRESENCE OF VITAMIN B IN MILK. E. NAGATA, J. Pediat. (Tokyo), Jan. 20, 1926, p. 82.

The author used domestic pigeons with polyneuritis for his experiments. He concludes: 1. All pigeons died when from 5 to 10 cc. of whole cow's milk was used. 2. They also all died when from 5 to 10 cc. of normal healthy human milk was used. 3. When from 15 to 20 cc. of whole cow's milk was used, the symptoms disappeared and recovery occurred. 4. The same result was obtained when the human milk was used in the same amount. 5. However, the same result was also obtained when human milk expressed from the breast of a woman affected with beri-beri was used in a 15 to 20 cc. amount. Thus, it appears that the effect of the three kinds of milk used in the experiments on polyneuritis of domestic pigeons is not essentially different, although it is usually believed that the polyneuritis is caused by the lack of vitamin B. If, therefore, avian polyneuritis is really due to the vitamin deficiency, it becomes apparent that the vitamin content of the three forms of milk is practically the same. Consequently, it is illogical to conclude that the human milk obtained from the breast of a beri-beri patient is deficient in vitamin B.

KATO, Los Angeles.

Prenatal Conditions

INTERRELATIONSHIP BETWEEN PATHOLOGIC CONDITIONS OF THE MOTHER AND OFFSPRING. FRED L. ADAIR, Northwest Med. **25**:531 (Oct.) 1926.

Adair summarizes the relations of mother and fetus as living in symbiosis, usually with mutual benefit, but occasionally each being of danger to the other. By implanting without the uterus, the fetus usually dies and often jeopardizes the mother's life. A diseased embryo may implant in the uterus and be cast

off, or the trophoblastic layers may overdevelop and form tumors. The fetus may elaborate toxic substances which either destroy it or poison the mother. The amount of the mother's nourishment has little effect on the fetus, but a deficiency of iodine, of calcium, of iron or of essential amino-acids or vitamins will have a marked effect on the infant's skeleton, teeth and blood. Syphilis in the mother usually causes late abortion, after the sixth month. Treatment of syphilitic mothers during pregnancy yields satisfactory results so far as the fetus is concerned. Vaccination of the prospective mother does not confer immunity to the fetus for smallpox or for vaccinia, but is valuable and not associated with untoward results.

Scott, Philadelphia.

Syndactylia with Localized Lipomatosis. H. Feriz, Virchows Arch. f. path. Anat. **260**:308, 1926.

Feriz reports two cases of unilateral syndactylia of the foot with localized lipomatosis. For the condition discussed he proposes the name macrodystrophia lipomatosa progressiva, and thinks it is to be differentiated from localized gigantism with syndactylism, that is, macrodactylia simplex congenita. The former he defines as a progressive tumor-like increase of adipose tissue, which develops in postfetal life on the basis of a congenital syndactylism and is associated with hypertrophic and dystrophic changes in the syndactylic bones. The lipomatous overgrowth is not heritable, although the syndactylia is. The cause of the adipose overgrowth, like that of the digital deformity, is unknown, but Feriz does not think that the former is a developmental anomaly. With the statement that he makes no claim for completeness, he tabulates 187 cases of partial gigantism which show all stages from simple hypertrophy of all the tissues to the dystrophic lipomatous condition described by himself. From this tabulation he selects nineteen cases which correspond to his own. A bibliography of 332 references is appended.

O. T. Schultz.

Twins. P. J. Waardenburg, Nederl. Tŷdschr. v. Geneesk. **70**:2859, 1926.

The author describes his observations of twenty-five pairs of twins of the same sex, seventeen of whom were girls and eight boys. Dactyloscopic investigation was made in twenty pairs. Like Poll and others, Waardenburg found that the dactylograms of single ovum twins correspond much better than those of double ovum twins, which are about the same as those of brothers and sisters. The investigation of the ovum membranes is, in the author's opinion, no reliable criterion for the diagnosis of single or double ovum twins. With regard to the question of hereditary identity, the author found some remarkable peculiarities. In a family with hereditary nystagmus, with three pairs of twins, he noted that the elder twin son and the elder twin daughter of two pairs of twins showed nystagmus, whereas the two twin sisters, with the exception of the nystagmus, resembled each other fully. He describes asymmetry in single ovum twins, that is, strabismus, hiatus in the teeth, hair-line, the form of the nose, etc. Many characteristics show deviations which are not hereditary. The author gives many examples of these variations, and finally discusses the problem of the bilateral symmetry of the body.

Van Creveld, Amsterdam.

Diseases of the New-Born

HEMOTHORAX IN A NEW-BORN INFANT. S. G. Ross, Canad. M. A. J. **16**:1108, 1926.

This is a report of a case of probable hemorrhagic disease of the new-born, with localization of hemorrhage in the pleural spaces. The condition developed suddenly on the fifth day. The infant refused to nurse; he became pale, and the respirations became very rapid, shallow and somewhat labored. Physical examination showed signs of fluid in the right lung. Necropsy showed the right pleural cavity filled with fluid and clotting blood, the lung being greatly compressed and collapsed. A small amount of blood was found in the left pleural cavity.

MOORE, Omaha.

THE LEUKOCYTE CONTENT OF THE KIDNEY OF THE NEW-BORN AND OF INFANTS. IRENE VON TROSSEL, Jahrb. f. Kinderh. **133**:127 (July) 1926.

Histologic examination of the kidneys of new-born infants, prepared with oxydase, gave the following results: 1. Physiologically, the kidney of the child is rich in leukocytes up to the sixth to eighth week. 2. Later, the leukocyte content is much reduced.

The causes for the increased leukocyte content of the kidney of the new-born may be due to leukocytosis, congestion, hydrogen-ion concentration or myelopoesis.

EHRMANN, Chicago.

UROBILIN IN THE NEW-BORN. M. WINTERNITZ, Klin. Wchnschr. **5**:988, 1926.

Urobilin is regularly found in the intestinal contents of the fetus, and the urine and stool of the new-born. This urobilin comes from the mother's blood. It is absorbed by the liver and excreted in the bile. The fetal liver possesses this excretory function as early as the seventh month, at a time when the kidneys normally have none. Bacterial urobilin formation in the intestine sets in a few hours after birth. Small quantities of urobilin are found in the serum during the fetal time and during the first days of life.

ARTHUR LOCKE.

THE PRESENCE OF GAS BACILLI IN MELENA NEONATORUM. WALTER HERGT, Monatschr. f. Kinerh. **32**:517, 1926.

This is a report of two cases of melena neonatorum in which large numbers of gas bacilli were found in the stools. Cultures of the lochia of the mother revealed the same organism. While these bacilli have been found in the stools of new-born infants, they have never been seen in such profusion as in these two cases. The author is inclined to ascribe pathogenic properties to them on account of their great numbers and the finding of them in the upper intestine as well as in the various viscera at necropsy.

PHYSIOLOGY AND PATHOLOGY OF THE NEW-BORN. REVIEW OF THE LITERATURE IN 1923 TO 1925. A. REUSS, Monatschr. f. Kinderh. **33**:38, 1926.

As the title suggests, this is a review of the literature of the years 1923 to 1925, with which the author is familiar. A number of articles are worth special mention. There seems to be no unanimity of opinion as to whether the diet of the mother has any effect on the size of the baby. Authorities disagree as to

whether any influence is exerted, and those who maintain that diet is of importance are not agreed as to which elements of the diet should be restricted. The most interesting statistics are those of Germany during the war and during the years immediately following. In spite of insufficient food and increased cost of living, no influence was noted on the size of the new-born babies.

The question as to whether roentgen rays applied to the mother have any effect on the fetus has caused some discussion. Some physicians report cases and experiments in which they believe congenital anomalies might be attributed to this cause.

The physiologic loss of weight following birth received a share of the discussion. Interesting observations show that this loss can be combated by 10 per cent sugar solution more satisfactorily than in any other way.

The pulse of the new-born infant averages 134, and in a few days drops to 118.

Cerebral hemorrhage is being discovered more frequently, especially injury to the falx. In 167 necropsies on new-born infants, eight-one, that is, almost half, showed such pathologic changes. In seventy-one, subdural blood effusions were present. Symptoms may not develop for two or three days. The conclusions forced on most observers are that the majority of cerebral hemorrhages do not produce clinical symptoms and in a sense can be called physiologic.

Congenital stridor was found to be due to thyroglossal cysts in five infants. Following puncture, the stridor disappeared.

Under the chapter headed "'Navel" is an instructive observation concerning the etiology of naval hemorrhage. Apparently contraction of the umbilical vessels is due to the increasing oxygen in the blood. There is danger of hemorrhage especially in those children who do not breathe properly.

New-born infants with tetanus are treated by injections of serum and by the subcutaneous use of 5 cc. of 4 per cent magnesium sulphate solution once or twice daily.

Icterus Neonatorum Gravis. W. Hoffmann and M. Hausmann, Monatschr. f. Kinderh. **33**:193, 1926.

This is a case report of a case of icterus neonatorum of the severe type. The authors include a number of other cases also, to call attention to what apparently has been overlooked, namely, that this type of icterus is associated with injury to the brain and often leaves the child with a grave cerebral defect. The rest of the article is a review of the literature and a discussion of the theories of pathogenesis and of the treatment. In neither case is our knowledge satisfactory. Occasionally, an infant may be benefited by not being fed from the mother's breast and obtaining breast milk elsewhere. In all cases, however, breast milk is superior to any other method of feeding.

Ichthyosis Congenita. Frankenhaus, Monatschr. f. Kinderh. **33**:310, 1926.

The author reports a severe case. Necropsy showed nothing definite in the internal organs. The causation probably lies in some defect of the germ plasm.

Gerstley, Chicago.

Asphyxia Neonatorum. Fritz Kermauner, Wien. klin. Wchnschr. **39**:1070 (Sept. 16) 1926.

In a review of 13,913 births, Kermauner found uncomplicated asphyxia neonatorum in 802 cases, with a mortality of 16.7 per cent in those spontaneously

born and of 12.4 per cent in instrumentally delivered infants. He is convinced that brain injury with damage to the vital centers is a primary cause of asphyxia. When amniotic fluid or plugs of mucus are found in the air passages, their aspiration may have been due to traumatic irritation of the respiratory center during labor. In seventy-three asphyxiated new-born infants examined postmortem, tentorial tears, brain injuries or hemorrhage were found in forty-seven. A few had inflammation of the lungs. Pressure of an enlarged thyroid gland on the trachea was observed twice, and intrasuprarenal hemorrhage occurred once. Fluid and mucus were seldom seen in the respiratory tract.

The author condemns all violent methods of resuscitation. He has abandoned tracheal catheterization because it is seldom properly performed, it often forces mucus into the respiratory tract, and it has caused trauma of sufficient degree to lead to interstitial emphysema. His conservative treatment begins with removal of mucus and fluid from the mouth and nose by catheter before any attempt at artificial respiration. This aspiration frequently must be repeated. Fluid is removed from the lungs by hydrostatic methods; warm baths are given; the skin is irritated, and lobelia and heart stimulants are administered.

OLMSTED, Seattle.

INJURY DUE TO THE LACK OF WATER IN BREAST-FED BABIES. H. HIRSCH, Ztschr. f. Kinderh. **40**:629, 1926.

In breast-fed infants during the first days of life, usually the third, seldom any later, there may occur a rise in temperature and a fall in body weight if the fluid intake does not meet the physiologic need. The fever signifies an inability of the body to lose weight by evaporation because of the lack of water. This disturbance can be of the lightest kind, restlessness, crying, hoarseness and fever, or collapse, drowsiness, inability to take fluid and uncontrollable vomiting may occur. Water, especially weak tea, lowers the temperature and causes the disturbance to disappear in the shortest space of time.

EMERSON, Boston.

ICTERUS NEONATORUM. P. H. KRAMER, Nederl. Tydschr. v. Geneesk. **70**:1-249, 1926.

In this article, the author gives the results of his extensive investigations in 100 cases of icterus neonatorum, and discusses the etiology. He reports the opinions of the different investigators on the subject (Am. J. Dis. Child. **30**:240 [Aug.] 1925). He agrees with the opinion of some authors that the appearance of icterus neonatorum depends on two factors, namely, the intensity of the hyperbilirubinemia at birth, and the bilirubin excreting function of the liver. With Schick, he considers the cause of the hyperbilirubinemia a destruction of maternal blood by the trophoblasts of the placenta, the purpose of this placental function being the accumulation of iron from the blood in the fetal organism. He demonstrated several times the presence of free iron in the blood of the umbilical cord. Some additional factors, such as the loss of water and the blood destroying work of the reticulo-endothelial system, are responsible for the increase of the bilirubinemia in the first days of life.

VAN CREVELD, Amsterdam.

Acute Infections

THE EPIDEMIOLOGY OF PNEUMONIA: A STUDY OF PNEUMOCOCCUS CARRIERS AMONG FOUR GROUPS OF PERSONS OVER A PERIOD OF MONTHS. J. P. POWELL, R. M. ATWATER and LLOYD D. FELTON, Am. J. Hyg. **6**:570, 1926.

In 418 observations on ninety-three persons in four groups—high school boys, medical students, student nurses and laboratory workers—in the same city, one person developed pneumonia. This was within the limits of expectancy for that period according to the city figures for the year. Presumably every one at some time during the year becomes a carrier of a fixed type pneumococcus. Waves of prevalence of the types appear suggesting seasonal variations, differing for the several types. There seemed to be a tendency for the fixed type to disappear from the mouth and throat within thirty days. Sex had no apparent influence, but within groups the distribution of types tended to be uniform. Persons in contact with pneumonia cases carry pneumococci more frequently than other persons, but contact with carriers may also be the source. In general, there is confirmation that pneumonia appears when infection with a pathogenic form of pneumococcus and a lack of resistance in the person coincide.

ETHEL B. PERRY.

THE ASSOCIATION OF TYPHUS FEVER WITH RECURRENT FEVER IN INFANTS. MEZBOURIAN, Arch. de méd. d. enf. **29**:441, 1926.

The occurrence of mixed or multiple infections in infancy is receiving closer study than heretofore. For the last fifteen years, Mezbourian of Constantinople has noted the frequent association of typhus and recurrent fevers in children and adults alike. Both of these infections flourish under identical conditions, and epidemics are so frequently coincident that one is almost tempted to believe there must be some affinity in their pathogenesis. Both of the diseases follow or accompany wars, emigrations and the crowding of large populations in unhygienic surroundings. They may be called the handmaidens of collective misery, suffering and unhappiness. Four classifications are described.

Recurrent Fever Preceding Typhus.—In this category, one finds the child stricken with uncomplicated recurrent fever. After a period of hyperthermia lasting five or six days, the temperature falls suddenly, to remain normal for several days and then rise from an invasion of typhus exanthemas, the access of fever in the primary attack often corresponding with the period of incubation for typhus.

Coincident Invasion of Typhus and Recurrent Fevers.—Here the latter, owing to its shorter course, is eclipsed by the more prolonged duration of typhus, and the crisis occurs at the end of the second week. It is evident that these cases of symbiotic infection would go unrecognized if removed from laboratory control, particularly in those patients not seen until the fifth or sixth day, when the typical eruption of typhus appears. With characteristic symptoms, few clinicians would, under these circumstances, search the blood for the spirilla of Obermeier.

Recurrent Fever Occurring During the Decline of Typhus.

Recurrent Fever Occurring During Convalescence from Typhus.

The writer also describes many atypical forms of this association, abortive, fulminating, prolonged, etc.

From ancient times to the present, practically all students of typhus have remarked the astonishing resistance to it during the period of infancy, resembling in this regard the refractory nature of yellow fever infection in the very young. All writers agree that the danger from typhus increases with each decade, and that the mortality under the age of 10 is low, many cases at this period running an afebrile course. These patients, unsuspected and untreated, furnish one of the most difficult problems, therefore, in the control of the disease. Mezbourian confirms these opinions and quotes his experiences during the Balkan War and the World War, declaring that typhus in infancy is excessively light and ephemeral through causes wholly unknown at present.

ABORTIVE AND RECURRENT TYPE OF PNEUMOCOCCIC PERITONITIS IN INFANCY. G. MOURIQUAND, M. BERNHEIM and A. RENDER, Arch. de méd. d. enf. **29**:572 (Oct.) 1926.

Pneumococcic peritonitis in the child is recognized as a distinct clinical entity appearing more commonly in females from 2 to 10 years of age. While in the adult this type of peritonitis is usually secondary, it is almost always primary in the young, only in rare instances succeeding pneumonia or other pneumococcic invasions. In its most common form it discloses the clinical picture of encysted peritonitis. The onset is abrupt. The child, previously in good health, suddenly complains of severe pain in the abdomen. Vomiting quickly ensues, and the facies becomes markedly altered; the temperature mounts rapidly and meteorism is noted. In most cases a fetid diarrhea develops. Soon this acute stage subsides; the vomiting ceases and the pain diminishes. After oscillating between 102 and 104 F. for several days, the temperature drops and the general condition of the patient is better. The second stage is marked by a collection of fluid clearly defined, either in the hypogastrium or near the umbilicus. This fluctuating mass tends to evacuate itself externally in the course of a few weeks, unless relief is secured by surgical intervention.

In striking contrast to this benign form is the type characterized by diffuse peritonitis, which is extremely rare. In these cases there is no tendency to localization, and the symptoms increase in severity until death. Surgical procedures are usually futile. To these common forms of pneumococcic peritonitis, described previously by Dieulafoy, Broca and others, the authors desire to add two further types, the abortive and the recurrent. Numerous instances of peritonitis following pneumonia, in which no suppuration occurred and permanent cure followed, have been reported by European observers. These cases could be included in the abortive group, but they must always be differentiated from appendicitis. In still other cases, recession of all the symptoms and apparent recovery has been followed by relapse or recurrence, and under the influence of some unknown factor the pneumococcus has assumed an exalted virulence and suppuration has been produced. These cases would be included in the second category. The author quotes instances to illustrate both types.

AMESSE, Denver.

VACCINATION AGAINST DIPHTHERIA. P. LEREBOULLET ET AL., Bull. et mém. Soc. méd. d. hôp. de Paris **50**:683, 1926.

Lereboullet and his co-workers have vaccinated 1,414 children with diphtheria anatoxin. A dose of 0.5 cc. was given at the first injection, 1 cc. at the second and third, with three and one week intervals. Two injections induced immunity

in 95 per cent; three in 100 per cent. The immunity still persisted up to eight and twelve months. Only in a little over 3 per cent of the cases, the children had to interrupt their usual occupations on account of vaccinal reactions. The elective age for immunization is between 2 and 3; the receptivity is then maximal, while the reactions are minimal.

ANATOXIN IN VACCINATION AGAINST DIPHTHERIA. FLANDIN, Bull. et mém. Soc. méd. d. hôp. de Paris **50**:691, 1926.

Flandin injected 295 children with diphtheria anatoxin. There were no cases of diphtheria among the vaccinated within a year.

IMMUNIZATION OF SCHOOL CHILDREN AGAINST DIPHTHERIA. HARVIER and RÉQUIN, Paris méd. **59**:456, 1926.

Harvier and Réquin vaccinated with diphtheria anatoxin 228 school children with a positive Schick test. Two subcutaneous injections of 0.5 and 1 cc. were given, three weeks apart. Control Schick tests showed immunity in 95.4 per cent after two injections, and in 64 per cent after one injection. Pronounced reactions from the injections were never noted in children under the age of 7. Therefore, regular vaccination with diphtheria anatoxin may be made in all children between 2 and 7, without a preliminary Schick test. The latter appears positive in 78 per cent of children of this age. Two injections should be followed by a control Schick test. It is superfluous when three injections have been given.

[ARCH. PATH.]

THE RHEUMATIC CHILD. RAY, Rev. internat. de l'enf. **1**:499 (June) 1926.

Dr. Ray is secretary of the British Committee on Rheumatism and a member of the Council of the "Save the Children" Fund. He outlines in a comprehensive paper the wide difference between rheumatic disorders in the child and in the adult, noting the insidious character of the disease in early life, particularly with respect to cardiac involvement. He gives great credit to the health authorities in America and stresses the need of instituting throughout England numerous cardiac clinics "which will deal with the situation in the best possible manner; namely, by prevention." A national campaign has been inaugurated with an advisory committee which includes several eminent cardiologists. This committee has already formulated proposals for a comprehensive scheme which will include the care of patients with acute and quiescent cases and convalescents. Rest homes or auxiliary hospitals will be established within easy reach of the large centers of population, some of these partaking of the nature of open air schools. In all of them efforts will be made, through the usual hygienic measures, to increase the resistance of the children. Prof. Leonard Hill calls attention in this connection to a fact not generally understood — that while the climate of England cannot boast of much actual sunshine, there is a fruitful source of ultraviolet radiation in the "skyshine" of areas not obscured by smoke. It is proposed to take full advantage of this by keeping the cardiac patients outdoors a considerable part of the time.

AMESSE, Denver.

ACTIVE IMMUNIZATION OF CHILDREN AGAINST DYSENTERY. KURT WEISE, Monatschr. f. Kinderh. **33**:1, 1926.

This is a review of the different methods employed to immunize patients against dysentery. The author's method consisted of growing the different strains of organisms on agar, making emulsions in salt solution and preserving in phenol. Before using, he tested the mixture to insure sterility. The inoculation consisted of 0.1 cc. of the killed organism emulsion injected intracutaneously and repeated once. Of 479 children in his wards thus treated, only two developed the disease. One of these had had only one injection and the other had been inoculated more than two months previously.

STUDIES ON THE DICK TEST. E. KRSTULOVIC, Monatschr. f. Kinderh. **33**:120, 1926.

The author tried to confirm the observations of the Dicks, but in a number of ways could not repeat their experiments.

1. He could not produce a typical scarlet fever by injection of the toxin.

2. Children without a history of scarlet fever gave 27.5 per cent positive Dick tests in contrast to the Dick figures of 41.6 per cent.

3. Nurslings gave negative reactions.

4. Children who had had scarlet fever gave as high a percentage of positive reactions as those with a negative history.

5. In the course of the disease children reacting positively decreased from 36 to 22 per cent, in contrast to the Dick figures of total disappearance of the reaction.

6. It is not certain whether a positive reaction should be diagnosed by a diameter of 0.5, 1, or 1.5 cc.

7. While scarlet fever convalescent serum neutralized the toxin, the toxin was also neutralized in one experiment by serum from a child whose Dick test was positive.

8. Moser serum in a neutralization experiment is less powerful than scarlet fever convalescent serum.

9. Children with positive Dick reactions when exposed to scarlet fever do not necessarily contract the disease.

10. Nobel and Orel's observations that pseudoreactions occur only in children with positive Pirquet reactions are confirmed.

THE WAITING TREATMENT OF DIPHTHERITIC LARYNGEAL STENOSES. FRANZ HAMBURGER, Monatschr. f. Kinderh. **33**:244, 1926.

This is a brief reply to a former article of one of Schlossman's assistants. Hamburger emphasizes that he advocated the conservative method of noninterference with diphtheritic laryngeal stenoses in 1921. As the heart is not affected by the poison of laryngeal diphtheria, he believes that operative interference and intubation should be used as a last resort and should not be employed too soon. He thinks, however, that Schlossman, through his assistant, has gone a little too far in the direction of noninterference and that each case must be considered by itself.

DIFFERENTIAL DIAGNOSIS BETWEEN DIPHTHERIA AND THE PSEUDOCROUP OF MEASLES. DETERING, Monatschr. f. Kinderh. **33**:402, 1926.

The author reviews the diagnostic signs that are supposed to distinguish diphtheria complicating measles from a pure measles croup. When all is said, however, the only sure test is the finding of the diphtheria bacilli. Diphtheria complicating measles gives a bad prognosis, which is explained by former observers on the basis that the serum does not affect this type of case. In the author's cases the mortality was due to the measles itself; i. e., the complicating pulmonary pathologic change at necropsy showed that the deaths were not due to the laryngeal stenoses. The antitoxin had cured the diphtheria. In the treatment of the measles croup itself, the author strongly advises delay of intubation until the last possible moment.

NEW CONCEPTIONS OF SCARLET FEVER: DICK REACTION; TOXIC STREPTOCOCCI IN PATIENTS WITH OTHER DISEASE; INTRACUTANEOUS IMMUNIZATION EXPERIMENTS. EUGEN KRAMAR and DANIEL FRANCZISZCZI, Monatschr. f. Kinderh. **33**:421, 1926.

The two observers have made a thorough survey of the scarlet fever toxin situation. Their material consisted of 500 children, mostly infants. Of these, 48 per cent of those already having had scarlet fever showed positive Dick tests and 60 per cent of those not having had the disease gave positive reactions. They agree with European rather than with American writers that the percentage of positive reactions increases rather than decreases during the 3 to 5 year period.

During the course of the diseases, many patients lose their susceptibility to the toxin, so that the test is not of great diagnostic value. On the other hand, there is great variability in the susceptibility of each patient. A test may be positive one day and negative another, or vice versa. Such variability in well children depends somewhat on their physical condition. The undernourished and emaciated show the greatest fluctuations in susceptibility and immunity. One single negative test does not mean that the child is immune.

In two children with strongly positive Dick reactions, streptococci were isolated from the throats. These organisms produced toxin that was identical with the Dick toxin. As the two patients had sore throats and positive Dick tests, the authors ask why the patients did not develop scarlet fever.

In the course of the experiments, the reactions of many more children became negative than became positive. The idea suggested itself that these intracutaneous doses in themselves might produce immunity. This seems to be exactly what happens. Further investigations proved that repeated intracutaneous inoculations of tiny doses produced immunity as fully as subcutaneous injection of the usual much larger dose. If these observations can be substantiated and if this immunity proves to be of any decided duration, such a method of immunization will do away with the unpleasant results of the larger dosage.

In their experiments, the writers first used American toxin and later toxin of their own make.

GRIP ENTERITIS IN INFANCY. S. ROSENBAUM, Monatschr. f. Kinderh. **33**:441, 1926.

Rosenbaum has made a brief review of enteritis associated with grip during 1923-1925. Some of the cases were severe enough to be confused with dysentery. On the whole, though, the number of cases of parenteral diarrhea is decreasing.

The author submits a number of theories as to the etiology, but leans to the idea that the diarrhea is due to the associated indigestion and to the swallowed mucus and germs.

GERSTLEY, Chicago.

PATHOLOGY OF SCARLET FEVER. N. SYSAK, Virchows Arch. f. path. Anat. **259:** 647, 1926.

Sysak summarizes the postmortem pathologic observations in thirty-two cases of scarlatina. A hemolytic streptococcus was obtained from the heart's blood in 90 per cent of the cases. The streptococci showed considerable variaton in cultural reactions and in virulence, to which variations the author believes the manifold character of scarlet fever may be ascribed. The changes noted in the internal organs were such as had been described by previous observers.

O. T. SCHULTZ.

EXPERIMENTAL SCARLET FEVER. I. W. HACH and N. P. BORDZILOWSKAJA, Ztschr. f. Hyg. u. Infectionskrankh. **106:**232, 1926.

The authors injected from 3 to 5 cm. of blood taken from three patients with scarlet fever on the second or third day of the disease intraperitoneally into eleven guinea-pigs. Five animals developed an attack of fever and an enlargement of the spleen. No streptococci were present in the blood used for the injection or in the tissues of the diseased animals. They do not contend that the disease produced in the experimental animals is equivalent to scarlet fever but they believe that the results are sufficiently suggestive to warrant further experimentation along these lines.

W. OPHÜLS.

SMALLPOX OR CHICKENPOX? D. J. HULSHOFF, Nederl. Tijdschr. v. Geneesk. **70:**758, 1926.

The author observed ten patients, in whom the differential diagnosis between smallpox and chickenpox was difficult. He fully agrees with the differential diagnostic characteristics as given by Ricker and Wanklyn (London). Of great importance therefore, are: 1. The extent of the vesicular exanthem in smallpox. The eruption is principally found on the face, neck and hands, and also on those parts of the body which are covered and which are more exposed to pressure. In chickenpox, the face is less severely attacked than are the chest, back and abdomen; the proximal parts of the extremities are attacked more severely than are the distal parts.

2. The eruption. In smallpox, on a certain part of the body all vesicles are of the same stage of development, while in chickenpox they are in different stages. The vesicle in smallpox is rather flat, while in chickenpox it looks like a blister.

3. Shape of the vesicle: Most smallpox vesicles go through the stage of umbilication; in a case of chickenpox an umbilicated vesicle is found only here and there.

VAN CREVELD, Amsterdam.

A CASE OF MENINGOTYPHOID. KATSUKI TADA, J. Pediat. (Tokyo), November, 1925, p. 63.

The author reports a case of meningitis developing on the tenth day of infection with *Bacillus paratyphosus B* which, gradually increasing in severity,

finally led to death in a boy, aged 12 years and 9 months. Necropsy was unfortunately unobtainable, but repeated examinations, both cultural and serologic, demonstrated beyond doubt the true nature of the complication. Since the first report of this kind by Kamen in 1890, the present case is the one hundred and third one reported.

PARALYSIS FOLLOWING MEASLES. REIZO SASAKI, J. Pediat. (Tokyo), March 20, 1926, p. 23.

The author reports three cases of paralysis following measles. After reviewing the literature on the subject, he concludes that cerebral, spinal, peripheral and hysterical paralysis appear during the period of convalescence, rarely during the eruptive stage. Of these forms of paralysis, the spinal type is the most frequent, and then the cerebral. The peripheral and hysterical types are rare and are easily confused with the spinal type. The cerebral paralysis is usually generalized but may be localized, and is often accompanied by aphasia and alaria. There may be an association of acute conditions such as convulsions, increase of tendon reflexes, stupor and lethargy. The spinal paralysis comes in stages. At first there is a pain or painful convulsions. The appearance of paralysis is gradual. Tendon reflexes disappear only to become exaggerated again. Disturbances of sensation and of the bladder and rectum may be frequent. Marked changes occur in the cerebral type of paralysis, and the condition progresses either to fatal termination or to recovery. In the spinal type of paralysis the patient progresses more slowly and recovers gradually.

KATO, Los Angeles.

THE BLOOD PICTURE IN TYPHOID FEVER DURING CHILDHOOD. KEN NAMAJI, JR., J. Pediat. (Tokyo), April 20, 1926, p. 7.

Namaji studied systematically the blood picture of sixteen typhoid patients, varying in age from 3 to 14 years. He concludes that during the febrile stage the hemoglobin and the number of erythrocytes decrease and during convalescence gradually increase during the afebrile stage and during convalescence, a few cases showed the presence of nucleated erythrocytes, and there were also cells showing basophilic degeneration and striated granulation. Leukopenia in typhoid fever at these ages is relative. In patients under 5 years, there is a more prolonged period of decrease in polymorphonuclears during convalescence than in older children. There is a comparatively marked deviation to the left of the Arneth sign. In patients under 5 years, the lymphocytes do not decrease after they have increased once in convalescence. Lymphocytosis of reinfection is seen in a small number of cases. The characteristic crossing of the curves of two main blood elements (Typhuskreuzung) is observed as in adults. Mononucleosis has no relation to age. Eosinophils and transitional cells decrease or totally disappear during the height of the disease and gradually reappear and increase during convalescence. Their increase due to reinfection is also seen in a few cases. In many cases, myelocytes, Rieder's cells and plasma cells are present. There seems to be no causal relation between the leukopenia and the diazo reaction.

Chronic Infections

ERRORS IN THE DIAGNOSIS OF TUBERCULOSIS IN CHILDREN. WILLIAM E. CARROLL, Am. Rev. Tuberc. **13**:479 (June) 1926.

Of 594 patients between the ages of 7 months and 15 years discharged from the Meriden (Conn.) sanatorium during the past five years, 54.4 per cent had the disease in some form, and 45.6 had no clinical tuberculosis. Of patients in whom a diagnosis of tuberculosis was established, 197 had pulmonary tuberculosis and 126 some extrapulmonary form. Sixty-seven had frank parenchymal tuberculosis of the adult type. Only one patient with tubercle bacilli in the sputum recovered.

Juvenile pulmonary tuberculosis of the nonmanifest type, hilum disease, peribronchial tuberculosis and early parenchymal involvement without râles, furnished the chief diagnostic problems. Typical clinical and physical observations are usually absent in these cases, so that the diagnosis must be made as much by exclusion as by positive evidence. Conditions which may simulate pulmonary tuberculosis closely are nonspecific chronic disease of the upper respiratory passages and accessory sinuses, pericarditis with small effusion and low grade pyelitis and sepsis. With these conditions excluded, the minimum standard of positive evidence should be a child continuously below par, unquestionable abnormality in the hilum shadows or lung markings as shown by roentgen ray, and a positive skin test.

Diagnostic difficulties arise, especially in two groups of patients; those who show few abnormal signs, and those who show a great many abnormal signs. In the first group, a diagnosis of tuberculosis should not be made unless the child's health is obviously impaired. Symptoms are more important than signs. Likewise, in children who present a great many abnormal physical signs, and whose general condition remains good, some condition other than tuberculosis generally exists. It should be remembered that bronchiectasis, chronic adhesive pleurisy, pulmonary cirrhosis and chronic bronchopneumonic infiltration are not rare in childhood. It is not true that lower lobe tuberculosis in children is relatively frequent compared with upper lobe lesions. It may be taken as a safe general rule that when the upper lobes are clear, a basal lesion is not tuberculous unless tubercle bacilli can be demonstrated in the sputum.

TUBERCULOUS CERVICAL ADENITIS. COLE B. GIBSON, Am. Rev. Tuberc. **13**:489 (June) 1926.

While, in the opinion of many, the presence of enlarged cervical lymph nodes indicates a certain degree of immunity to pulmonary tuberculosis, painstaking treatment of the condition is justified by the following considerations: "Healed in" lesions do not represent a cure, but merely latent foci from which infection may spread should the general resistance be lessened. The symptoms of emaciation, fever or anemia may of themselves demand alleviation, and by their presence render the child more susceptible to acute infections.

In the author's experience, heliotherapy is the most valuable therapeutic agent. Tuberculin is of little value. Surgery may be useful in a small percentage of cases after nonsurgical measures have failed. Gibson has had no experience with the roentgen ray, though favorable, even enthusiastic, reports as to its value have been published. The Calot method of treatment by aspiration and injection, when used in conjunction with heliotherapy, is highly successful. Direct or specific measures should not be the sole reliance in these cases. Foci

of infection in tonsils, adenoids and teeth should be eliminated, and careful attention should be given to proper food, fresh air and general hygienic measures.

A Tuberculosis Survey of Extremely Underweight Children. Katherine H. K. Wolfe, Am. Rev. Tuberc. **13**:506 (June) 1926.

The following observations are based on the examination of several hundred underweight (Lincoln, Neb.) school children, of whom 60 per cent were found to be tuberculous. The incidence of "cryptic" tonsils, infected sinuses and organic heart defects was greater in nontuberculous than in tuberculous children. Persistent coughs, colds, nasal obstruction, constipation and indigestion were more frequent in the tuberculous group. A great majority of underweight children live on a deficiency diet, consisting chiefly of acid-forming foods. An almost perfect negative correlation was found to exist, in extremely underweight children, between the consumption of an excessive amount of sweets and loss of appetite for vegetables, with the exception of potatoes. Spontaneous improvement in the condition of these children is not to be expected, since they do not outgrow bad food habits, and resistance to sinus infection does not increase with age.

The Care of the Preventorium Child. Everett K. Greer, Am. Rev. Tuberc. **13**:524 (June) 1926.

An effort is being made to diminish the future consumptive population by admission to this institution (the Ramsey County, Minn., Preventorium) of children between the ages of 5 and 12 years, who have been intimately exposed to tuberculosis, who give a positive skin reaction and whose general condition is below normal. The measures employed to this end are rest and fresh air, supervised activities, well balanced and adequate diets, eradication of infectious foci, heliotherapy and air baths, tuberculin, open air schoolroom, child guidance survey and follow up work. The latter has been so well done that the condition of all but seven of 223 children discharged since 1915 is known, of whom only two have developed tuberculosis.

Smith, Ogden, Utah.

Immunobiology of Tuberculosis in Childhood. D. Lebedew and A. Ginsburg, Monatschr. f. Kinderh. **33**:97, 1926.

By means of the serum reaction of Besredka and of Negre-Boquet, the authors examined thirty-nine children for tuberculosis. In only two cases was the result faulty. They conclude that the reaction is very sensitive. In cases in which no clinical symptoms of tuberculosis are present but the reaction is positive, they conclude that the patient is biologically but not clinically tuberculous.

Gerstley, Chicago.

Tuberculosis: Primary Infection and Reinfection. Jaroslav Jedlicka, Čas. lék. česk. **64**:741 (May) 1925.

The author reviews the clinical and experimental work on tuberculosis since Koch's work in 1891. He shows that immunity follows repeated minute infection and a high death rate follows massive reinfection in animals. In adults, necropsy reveals over 90 per cent residual primary tuberculosis in the different series. The primary infection is 95.67 per cent respiratory; 3.61 per cent intestinal and 0.72 per cent bucco-esophageal. Kimla reports a necropsy

incidence ranging from 13 per cent in the 1 to 6 month group to a maximum of 77 per cent at 13 years. The development of the lesions from the standpoint of contiguity, lymph, blood and endobronchial propagation is discussed. Primary infection may occur at any age, but is more than likely to occur in childhood. No clear case of reinfection was reported by Kimla in which the patient was under 7 years, and Aschoff's organization reports one at the ages of 9, 12 and 14 years. Clinically, tuberculosis is divided into primary (healed), secondary (metastatic), tertiary (localized lesion) and the fourth group with healed primary lesions and secondary exogenic aerogenous reinfection.

STULIK, Chicago.

RECTAL ADMINISTRATION OF ARSPHENAMINE IN THE TREATMENT OF CONGENITAL SYPHILIS. S. ISODA, J. Pediat. (Tokyo), Dec. 20, 1925, p. 87.

The author treated fourteen patients who had congenital syphilis by giving arsphenamine as a retention enema, after a thorough cleansing of the rectum by glycerine enema. He noted that its effect is distinct enough to justify its use in young infants, the effect being greatest in the skin and the mucous membrane, the bone lesions being the slowest to respond. A Wassermann reaction has been rendered negative after a course of treatment by this method.

KATO, Los Angeles.

Internal Diseases

THE EFFECT OF EFFORT ON THE SIZE OF THE HEART. BURGESS GORDON, Am. J. Roentgenol. **14**:424 (Nov.) 1925.

A definite diminution in the size of the heart immediately following effort was found both in Marathon runners and in rabbits. The rabbits included several with a spartein myocarditis and hypertrophy. Physiologic recovery was rapid, but in both series the heart did not return to normal size for about two hours. Secondary studies made on the Marathon runners showed that many years of most vigorous physical effort did not produce cardiac hypertrophy. It seems, therefore, that exercise does not produce cardiac dilatation and that prolonged athletic training fails to develop hypertrophy of the heart.

THE DIAGNOSIS AND TREATMENT OF INTRATHORACIC LYMPHADENOPATHY FROM A ROENTGENOLOGIC STANDPOINT. JOHN D. LAWSON, Am. J. Roentgenol. **14**: 427 (Nov.) 1925.

The hilum shadow is made up of (1) vascular structures, (2) the large bronchi, (3) the fibrous tissue and pleural reflections and (4) mediastinal and bronchial glands. The latter are subdivided into tracheobronchial, intertracheobronchial, bronchopulmonary and pulmonary. Primary tuberculous adenopathy accounts for possibly 80 per cent of intrathoracic glandular enlargement. Other causes are secondary adenopathy of pneumonia, influenza, bronchitis, bronchiectasis, pertussis and syphilis. Less frequent are the blood cell malignant diseases, such as leukemias, lymphosarcoma and Hodgkin's granuloma. In children the clinical observations most often due to tuberculosis or of pyogenic origin are: cough, often croupy; preadolescent retardation, ascribed usually to the frequently associated hypertrophic tonsils and adenoids; frequent colds; low grade fever; cervical adenitis in 50 per cent of cases; positive D'Espine's sign and frequently a spinalgia of Petruschky (pressure and pain in the upper posterior part of the spine). Roentgen-ray therapy is of value because lymphatic tissue is the

most susceptible of all tissue to irradiation. Hilum adenopathy, chiefly tuberculous, is an entity, which is especially recognizable by roentgenology. If tuberculous, it is dependent on a primary focus, and the treatment should be roentgen-ray therapy in conjunction with medical and hygienic measures.

THE DISEASED APPENDIX AS A CAUSE OF ACIDOSIS IN CHILDREN. A. L. GRAY, Am. J. Roentgenol. **14**:436 (Nov.) 1925.

Chronic appendicitis is overlooked possibly because of its infreqency in children as compared to acute appendicitis. The author bases a diagnosis of a pathologic appendix on: (1) abnormalities in the lumen, (2) marked delay in emptying after the cecum has emptied, (3) abnormal fixation or fixed kinking, (4) the presence of retained fecal concretions, (5) tenderness, definitely in the appendix, (6) pylorospasm and (7) ileal stasis or colonic spasticity. In the cases cited, no history of pain in the region was obtained, and tenderness was absent. In "cyclic vomiting" and other gastro-intestinal conditions often classed as "acidosis," the appendix must not be overlooked as an etiologic factor even though the roentgen-ray examination is negative.

DYSCHESIA. HARRY J. ISAACS and M. I. KAPLAN, Am. J. Roentgenol. **14**:439 (Nov.) 1925.

Dyschesia or torpor recti is a common form of constipation. There is no delay in the propulsion through the proximal colon, but retention is found in the atonic and dilated sigmoid and rectum. There is an accumulation due to habitual neglect of the reflex of defecation or painful defecation following fissure in ano, hemorrhoids, anal ulcer or pelvic peritonitis. In making a differential diagnosis these conditions should be considered: (1) atonic constipation, (2) spastic constipation, (3) redundant colon, (4) diverticulitis of colon, (5) Hirschsprung's disease, (6) Meckel's diverticulum, (7) organic obstruction, in (8) tuberculous peritonitis and (9) constipation due to anomalies and fissures. Cathartics are harmful in that they merely increase irritation in the colon and do not affect the rectum. Oil and warm water retention enemas, and oil and agar by mouth are the treatments of choice.

STULIK, Chicago.

ACUTE NEPHRITIS IN CHILDREN, WITH SPECIAL REFERENCE TO THE TREATMENT OF UREMIA. KENNETH D. BLACKFAN, Bull. Johns Hopkins Hosp. **39**:69, 1926.

Of forty-six cases of nephritis which formed the basis of the study, only five were called chronic nephritis, twenty-four were classified as acute glomerular nephritis, fourteen as acute tubular nephritis and three were mixed. For the acute tubular nephritis the term nephrosis is used in contradistinction to nephritis, since the histologic changes are degenerative rather than proliferative.

The distinguishing features in these two forms of nephritis are shown in the table.

Features	Acute Glomerular	Acute Tubular
Onset	Acute	Insidious
Urine	Blood	Albumin
Nonprotein nitrogen	Increased	Normal
Serum protein	Normal	Low
Edema	Slight	Marked
Arterial tension	Increased	Normal
Uremia	Frequent	Rare
Recurrence	Rare	Common
Fatal termination	Uremia	Secondary infection
History of infection	Common	Rare

Eleven patients with acute glomerular nephritis developed uremia. In addition to cerebral symptoms, hypertension, hematuria and visible though not necessarily marked edema developed. The patients were treated during the uremia with intravenous injections of a 1 per cent solution of magnesium sulphate and large amounts of magnesium sulphate by mouth and by rectum.

Observations made in each of the eleven cases showed clearly the relationship between (1) the cerebral manifestations, (2) the blood pressure and (3) the edema in this form of uremia. Edema and continued rise in blood pressure, visual disturbances, coma and convulsions followed almost invariably. Decrease of edema and lowering of the blood pressure were coincident with the disappearance of cerebral symptoms. The symptoms were not dependent in any case on the degree of nitrogen retention, hematuria or anuria.

The author believes that increased intracranial pressure is the primary cause of the uremic symptoms, and that the increased arterial tension may be the result of increased intracranial pressure and is a compensatory adjustment.

Treatment which caused a lowering of the intracranial pressure (hypertonic solutions by vein or mouth) caused prompt improvement in the cerebral symptoms.

LYTTLE, New York.

THE DIFFERENTIAL DIAGNOSIS OF CONGENITAL HEART DISEASE. EDWARD WEISS, M. Clin. N. Amer. **10**:185 (July) 1926.

The classification of congenital heart disease into a cyanotic group (venous-arterial shunt) and a noncyanotic group (arterial-venous shunt), simplifies the consideration of the etiology and clinical manifestations of this imperfectly understood class of cases.

Venous-arterial shunt occurs with (1) ventricular septal defects associated with pulmonary stenosis; (2) complete absence of the cardiac or arterial septum, and (3) dextroposition of the aorta. The most common anomaly is a combination of pulmonary stenosis, defective ventricular septum and dextroposition of the aorta. Symptoms typically found in this group are congenital cyanosis aggravated by exertion, clubbing of the fingers and dyspnea. Polycythemia and splenomegaly may also occur. The usual observations in the chest are a prolonged harsh murmur, most pronounced over the pulmonary area, thrill, weak or absent pulmonary second sound and increased dulness to the right. Many patients die in childhood; others on reaching adult life fall victims to pulmonary tuberculosis or to bacterial endocarditis developing at the site of the defect.

In arterial-venous shunt, cyanosis does not occur unless, as a result of change in the pressure in the lungs, a reversal of the shunt is brought about. The functional capacity of the heart is not seriously impaired, and persons with these defects may live a normal length of years. The anomalies commonly found in this group with their symptoms are:

Patent ductus arteriosus. This condition is difficult of diagnosis in early life, and may at that time be symptomless. The physical signs, in the absence of other defects, are a harsh systolic or continuous (machinery) murmur in the pulmonary area transmitted upward, thrill, accentuation of the pulmonary second sound and dilatation of the pulmonary artery. The presence of this condition seems greatly to favor the development of bacterial endocarditis. Vegetations arise on the pulmonary side of the ductus, and may extend downward to the cusps.

Patent foramen ovale and auricular septal defects are the commonest conditions found in the noncyanotic group, and may remain symptomless unless changes in the pressure in the pulmonary circulation occur. Murmurs are inconstant and variable, but are usually systolic in time, and a thrill is usually absent. The roentgen ray shows hypoplasia of the aorta, frequently dilatation of the pulmonary artery and general enlargement of the heart.

Ventricular septal defects seldom occur alone. Rarely giving rise to symptoms, their presence may be recognized by the existence of a harsh, even systolic murmur, often with thrill, heard over the middle and along the left border of the sternum. The roentgenogram shows no abnormal shadows. The only danger lies in the likelihood of the development of vegetative endocarditis about the edges of the defect.

Patients with arterial venous shunt should therefore be protected particularly from two dangers: from such strain as might convert an arterial venous into a venous arterial shunt, and from bacterial endocarditis originating in focal infections elsewhere in the body.

SMITH, Ogden, Utah.

ESSENTIAL OR PRIMARY HYPOTONIA IN YOUNG CHILDREN. JACOB SOBEL, M. J. & Rec. **124**:225 (Aug. 18) 1926.

The purpose of this paper is to direct attention to a class or group of children in whom there exists a primary or essential loss of muscle and joint tone, a muscular and joint atony, without the presence of any basic physical or mental disturbance, and without any evident gross pathologic changes in the muscles, joints or bones.

These children are brought to the physician because they are late in walking, because they walk with a limp, or because they do not sit up properly or hold the head erect. With the exception of the finding of hypotonia of the muscles and joints, the results of the physical examination of the child are usually negative. When he sits, his spine is kyphotic or scoliotic. He has hyperelasticity of the wrist and fingers. He has abnormal lateral motility and hyperextension of the knees. He also has hyperextension of the hips and shoulders, sometimes to the point of showing subluxation of the joints at will. There is also a group showing milder grades of hypertonia. Some of these children have shown hypotonia of the diaphragm when examined by the fluoroscope. These conditions are often mistaken for rickets, paralysis or mental deficiency. Most of the patients improve or recover though it may take years. The treatment should be massage, warm baths, sunlight, proper hygiene, cod liver oil and syrup of iodide of iron.

WILLIAMSON, New Orleans.

PYELITIS IN CHILDREN. J. CLYDE MOORE, Nebraska M. J. **11**:381, 1926.

Two types of pyelitis in children are described; one, primary in the kidney, and the other secondary to foci of infection. Upper respiratory and gastrointestional disorders are the most common predisposing condition in the latter. Diagnosis would be made more frequently if the condition was suspected more frequently. Treatment is by removal of foci of infection, and the alternate administration of alkalis and methenamine.

HAMILTON, Omaha.

RHEUMATISM AND CHRONIC INFECTIVE TOXIC STATES IN CHILDREN. C. P. LA PAGE, Practitioner **117**:90 (Aug.) 1926.

Chronic infections arise from localized foci, and many such infections are similar in their symptoms and signs.

The word rheumatism and the prefix rheumatic are too frequently used. In chronic rheumatism the distinctive features are endocarditis, chorea, nodules under the skin, chronic tonsillitis and bowel trouble. The chronic toxic states from localized infection are many — for instance, tuberculotoxic, streptotoxic, etc.

The signs and symptoms of these chronic toxic states may be summarized as pallor, loss of tone of muscles, disordered digestive system, nasopharyngeal catarrh and bronchitis; loss of tone of blood vessels, reduction of the ductless glands; headache, irritability, and tic involving the nervous system, etc.

The treatment must be stated under three headings as (1) curative, (2) palliative and (3) preventive.

Tonsils and pharyngeal vegetation should be removed. Chronic bowel infections, infections of the gums, pyelitis, vaginitis, bronchiectasis, chronic otitis, abscesses of the bone or skin and infected lymphatic glands should all be treated directly.

Palliative treatment includes the use of salicylic acid, change of climate, artificial light, rest, etc.

Preventive treatment consists in avoiding dampness, irritating atmospheres, bad food, deficient sleep, draughts and exposure. Bad hygiene, badly chosen food and life in airless, crowded areas all play their part; finally, the present day life of the child with schools, street cars, cinemas, etc., gives much more opportunity for infections than formerly.

GELSTON, San Francisco.

MEGACOLON IN THE CHILD. PAUL LETONDAL, Thèse de Paris, 1925.

The author presents a clear picture of the anatomic pathology, the symptomatology and the clinical observations and treatment in megacolon. Sixty-three concise case records are given and also an extensive bibliography. Only two theories as to the etiology are discussed. According to the first theory originally advanced by Hirschsprung, the dilatation is a congenital condition of embyronic origin; according to the second theory, it is a retrodilatation secondary to some obstacle. From a consideration of the cases, the author feels that neither theory is sufficient to explain them all, but that all the cases may be explained by one or the other theory. Cases of dilatation and of lengthening and thickening of the colon at birth are undoubtedly explained by the first theory. But there are many infants who have no symptoms until a much later time, in whom twisting or narrowing of the loops at the level of the sigmoid may be shown to exist. The comparatively greater length of the sigmoid in the infant and the narrowing at its union with the rectum make such occurrences more possible than in the adult. Instances are also reported in which bands of adhesions have been found.

Many patients may present the symptoms of obstinate constipation and abdominal distention; when they are examined by the roentgen ray it is found that these symptoms are not those of true megacolon. The sigmoid in these patients may show many extra loops, the condition being designated as dolicocolon. If there is not a considerable and consistent dilatation of the colon, confirmed by roentgen-ray examination and accompanied by the clinical syndrome, the diagnosis of megacolon should not be made.

The prognosis is grave. Complications may arise owing to pressure on other organs or perforation of the intestine. In the younger infant, an intercurrent infection may be fatal. The type of dilatation, whether partial or complete, is also of significance. Some success has been attained by medication with complete daily evacuation by high enemas.

Surgical intervention is indicated when the patient does not respond to treatment as well as when some anatomic obstacle is suspected.

LESLIE, Chicago.

A MILD FORM OF JUVENILE DIABETES. A. HEIMANN-TROSIEN and H. HIRSCH-KAUFFMANN, Monatschr. f. Kinderh. **32**:357, 1926.

This is a discussion of juvenile diabetes, and a case report of a child in whom it was difficult to differentiate diabetes of pancreatic from that of renal origin. The diagnosis was finally made in favor of the pancreatic origin of the disease because there were: (1) hyperglycemia with glycosuria and acetone excretion on a mixed diet; (2) a decided diminution of tolerance to carbohydrate during the course of an intercurrent infection; (3) an immediate response to small doses of insulin.

HELMINTHIASIS IN CHILDHOOD. H. BRUNING, Monatschr. f. Kinderh. **33**:18, 1926.

This is a review of the literature on helminthiasis for the years 1924 and 1925. Many of the articles are concerned with statistics as to the frequency of the various types of these parasites. In Europe and in China they are surprisingly common.

As regards diagnosis, one or two points were interesting. One observer devised a skin test for ascariasis and applied powdered extracts of the worm to the excoriated skin. He claimed that he obtained urticarial wheals over the abraided spot within fifteen minutes in positive cases. The roentgen-ray technic has been so perfected these days that some German writers maintain that they can demonstrate some types of worms in the roentgenogram. After a worm cure these shadows disappear.

With regard to treatment, in spite of the great number of new drugs on the market, none of them have any advantage over the recognized remedies.

CONCERNING IDIOPATHIC CARDIAC HYPERTROPHY. E. KRSTULOVIC, Monatschr. f. Kinderh. **33**:113, 1926.

To show the fallacies of diagnosing idiopathic cardiac hypertrophy without necropsy, the author quotes a case typical in every way in which necropsy showed the condition to be due to a myocarditis associated with a mild nephritis.

PATHOLOGY OF THE ESOPHAGUS IN CHILDHOOD. CARL STAMM, Monatschr. f. Kinderh. **33**:147, 1926.

Stamm reports two interesting cases. In the first, there was an undiagnosed congenital diverticulum of the esophagus in connection with other anomalies. In the second, the child swallowed lye and developed a stricture of the esophagus which later produced symptoms suggestive of spasm. Three years later, the dilated esophagus above the stricture produced on the roentgenogram a picture suggesting a diverticulum. The child died following operation, and necropsy revealed only a dilated esophagus.

THE CLINICAL SIGNIFICANCE OF THE SO-CALLED SCAPHOID SCAPULA. BRUCKNER, Monatschr. f. Kinderh. **33**:289, 1926.

Bruckner presents a brief review of the literature on the subject of scaphoid scapula. He believes that no one has improved on his original theory; namely, that this observation is highly significant of congenital syphilis. However, he is willing to admit that it may be also simply a sign of degeneration.

A NEW TREATMENT FOR THRUSH. RUDOLF FISCHL, Monatschr. f. Kinderh. **33**:307, 1926.

In obstinate cases of thrush, the writer paints the affected part every two hours with a 2.5 per cent solution of solution of ferric chloride, G. P. The response to this treatment is prompt; there is no injury to the mucus membrane, and there is no effect on the gastro-intestinal tract or the kidneys.

GERSTLEY, Chicago.

PERORAL RESORPTION OF INSULIN. W. FORNET, Wien. klin. Wchnschr. **39**:1109 (Sept. 23) 1926.

Fornet has previously reported that insulin is efficacious as an antidiabetic when administered perorally with bile in the form of a pill. He has found insulin given per os to be less active quantitatively than by subcutaneous injection. Qualitatively, however, the action was identical except for absence of the sudden lowering of blood sugar content. He now asserts that three effects which have been noted in nondiabetic persons after hypodermic administration of insulin are also constantly seen when insulin is given by mouth: 1. The urine shows deviation of polarized light to the left. 2. After a period of continuous administration, discontinuance of insulin causes a transient glycosuria. 3. Vogt has reported that giving insulin pills results in a striking addition in weight.

The author concludes that the effect of peroral administration is a more accurate criterion of the true action of insulin than is the effect seen after unphysiologic hypodermic injection.

OLMSTED, Seattle.

INVESTIGATIONS WITH THE DUODENAL TUBE IN PATIENTS SUFFERING FROM TROPICAL SPRUE. P. B. STEENIS, Nederl. Tydschr. v. Geneesk. **66**:117, 1926.

In three cases of tropical sprue, the excretion of the liver and the pancreas was studied by analysis of the duodenal content. In all cases the amount of bile substances (bilirubin, bile salts and cholesterin) was lower than normal. The bile salts were mostly decreased, then the bilirubin. In correspondence with this, the amount of urobilin excreted in twenty-four hours in feces and urine (determined by the method of Terwen) was much decreased in two cases. In the third case the amount of urobilin corresponded to a low normal value, but at the time that this determination took place, this patient was nearly well, the feces were nearly normal, and there was only one stool daily. The quantitative urobilin determination in the feces that corresponded fully with the direct determination of the bile excreted in the duodenum. The lipase, trypsin and amylase of the pancreatic fluid were found to be excreted within normal range. By bacteriologic examination in two cases, *Bacterium coli* was cultivated from the duodenal content; in the third case streptococci were cultivated.

VAN CREVELD, Amsterdam.

CARDIAC RHABDOMYOMA. H. SIKL, Čas. lék. česk. **64**:757 (May) 1925.

The author says that the reasons why more cases of rhabdomyoma of the heart are not reported are the frequency of associated tuberous sclerosis of the brain and the fact that therefore necropsies are not performed when the patients have had epilepsy or have been idiots as a secondary condition. In the case reported, that of a girl, aged 9 months, the clinical diagnosis was congenital debility, organic heart disease, micropolyadenitis, cyanosis, cleft palate and harelip. At necropsy, multiple rhabdomyoma of the left ventricle was found. The question of neoplasm or maldevelopment, Purkinje cell or muscle fiber origin, proliferation or degeneration is discussed. Histologic and embryologic data are cited.

CONGENITAL STRUMA. JAN ROUBAL, Čas. lék. česk. **64**:795 (May) 1925.

The author cites Wolfler's classification as simple hypertrophy, telangiectatic, cystic, fibrous and fetal adenoma. Zielinska adds a struma vasculosa. Of the author's thirteen patients, three had an associated anencephaly and one had a congenital chondrodystrophy. In all of the cases an increased amount of specific parenchyma with or without colloid was present, and in some there were mitotic figures in the cells. Often a macroscopic enlargement of the thymus is found, possibly as an associated internal secretory phenomenon.

STULIK, Chicago.

PHYSIOLOGIC BLOOD PRESSURE IN INFANTS. K. IKEDA, J. Pediat. (Tokyo), September, 1925, p. 197.

The author studied blood pressure in 589 Japanese infants who showed no apparent pathologic change. His general observations are as follows: There seems to be a direct relation of body weight to blood pressure. The average blood pressure of the infants at twenty-four hours after birth is 60.6 mm. of mercury, which increases up to 64.8 mm. on the fifth day, but there is a drop to 58.8 mm. on the sixth day when the initial weight loss reaches its maximum. From this time, however, pressure increase is steady and rapid during the first four weeks, the average pressure reading being 62.2 mm. at the end of the first week, 68.7 mm. the second, 72.7 mm. the third, and 74.9 mm. at the end of the fourth week. From the second month on, the increase in blood pressure is steady though not as great as it is during the first month. At the end of the first year, the male infants show the average blood pressure of 84.6 mm. and the females, 82.5 mm. In the same study the author notes that the blood pressure decreases with the appearance of icterus in the newborn in agreement with the observation may by Mensi. He also finds that the act of nursing increases the blood pressure on an average of 8.96 mm.

KATO, Los Angeles.

HEMOCLASTIC CRISIS IN CHILDREN. T. FUSEKI, J. Pediat. (Tokyo), October, 1925, p. 33.

Using the technic described by Widal, who seemed to have demonstrated the occurrence of so-called hemoclastic crisis in hepatic insufficiency, Fuseki tested the phenomenon in fifty-three sick children, the majority of whom had catarrhal jaundice. His summary is as follows: (1) Cases of catarrhal jaundice showed absence of hemoclastic crisis; (2) in other cases in which

symptoms pointed to hepatic insufficiency, the test was negative; (3) in nurslings, except in one case of beri-beri, the test was positive in every type of disease; (4) blood pressure did not show parallel change with the decrease in white cells. On the basis of these observations, the author concludes that in infancy and childhood the test has little value as a means of diagnosis.

A Case of Biliary Calculus in a Syphilitic Infant. Yoshio Kishi, J. Pediat. (Tokyo), March 20, 1926, p. 1.

The author reports a case of an infant, aged 46 days, who was brought to the pediatric clinic of Tohoku Imperial University because of emaciation and convulsions. The father had a three plus Wassermann reaction and the mother gave a history of one miscarriage and one stillbirth. The infant had as many as thirty-two convulsive attacks a day during its stay in the hospital. Just one day before death, it developed a severe degree of jaundice. At necropsy the gallbladder was seen to contain a number of yellowish-white granules and three soft rough calculi about the size of a large flaxseed.

Insulin Treatment of Nondiabetic Acidosis. Takuichi Miyake, J. Pediat. (Tokyo), March 20, 1926, p. 8.

Miyake used 6 per cent glucose with a various number of units of insulin in the treatment of acidosis due to enterocolitis. He found this method of decided benefit as compared with other older methods of combating acidosis. He noted that urinary acetone became negative from four to twenty-four hours after the treatment, and when it became positive, he reinstituted the glucose-insulin treatment. There was no hyperglycemia in any case. Insulin injection temporarily increased the pulse rate, but no effect was seen on respiration. Rice-water, fruit juice, glucose solution and epinephrine hydrochloride solution should be at hand for the immediate treatment of hypoglycemia if it should intervene. Athreptic infants tolerate insulin poorly. Instead of glucose proctoclysis, Miyake used subcutaneous injection of isotonic glucose solution. This method of treatment may be used for cyclic vomiting, which is ordinarily conceived to be a form of acidosis.

Nervous Diseases

Pneumocephalus (Intracranial Pneumatocele or Aerocele). Walter E. Dandy, Arch. Surg. **12**:949 (May) 1926.

Dandy reviews the literature on this interesting condition and describes three additional cases from his own experience. He points out that there are two possible sources of air within the skull: First, and by far the most common, an artificial opening between the interior of the cranial vault and the external air; second, an aerocele formed by gas-producing organisms. A fracture line extending through the paranasal or mastoid sinuses is the most frequent artificial opening through which the air may enter, although operative defects, chronic erosions and destruction of the floor of the skull by tumor or a dilated third ventricle in hydrocephalus may also be factors. A compound fracture of the skull is not enough to produce a pneumocephalus. In order to displace the cerebrospinal fluid, the air must be forced inward under pressure, as may occur in coughing, sneezing, straining or swallowing. Within the skull the

air may be found in the subdural or subarachnoid spaces, within the cerebral substance or contained in the ventricle. An air cyst within the cerebral substance is the condition most frequently encountered.

The most usual route of entrance of the air is by way of the accessory sinus subsequent to a fractured skull. Fractures through the paranasal sinuses seem to be followed by a pneumocephalus more commonly than fractures through the mastoid, for the reason that during coughing, sneezing or swallowing more direct pressure is put on the nasal opening and air is thus forced into the cranial cavity. The variety of pneumocephalus is dependent on the sinus involved, the exact character of the fracture and the length of time air has remained in the cranial chamber.

The symptoms of pneumocephalus are principally those of increased intracranial pressure. They may come on immediately or a long interval after the fracture has occurred. The presence of the aerocele is usually entirely unsuspected. An acute or chronic hemorrhage or abscess is the condition most frequently diagnosed. But if following cranial trauma a cerebrospinal leak occurs, particularly if this escape of fluid is precipitated by or subsequent to coughing or sneezing, and the signs of intracranial pressure develop, the possibility of a pneumocephalus must always be considered. The absolute diagnosis is made by the roentgen ray.

Surgical treatment is indicated to close the aperture through which the air entered the cranium. Especially is this indicated if a cerebrospinal leak exists. The presence of the air in itself is not a source of danger. It is the possibility of infection reaching the subarachnoid space through the compounded skull fracture that must be taken into account. To prevent this from occurring, the position of the fracture line and the tear in the dura must be carefully located and an attempt made to close the dural defect by suture or implantation of a graft.

THE INFLUENCE OF DECOMPRESSION OPERATIONS ON EXPERIMENTALLY PRODUCED PAPILLEDEMA. LOYAL DAVIS, Arch. Surg. **12**:1004 (May) 1926.

The efficacy of subtemporal decompression in the prevention of papilledema due to increased intracranial pressure was tested. Experimental lesions simulating brain tumors were produced in dogs by the insertion into the brain of gelatin capsules containing dyed agar agar. As this material absorbed fluid from the brain, it swelled and simulated the expansile growth of a neoplasm. In this way, owing to a localized increase in the content of the intracranial cavity, a definite measurable bilateral papilledema was produced in all cases. The swelling of the disk appeared within from thirty-six to seventy-two hours. On the death of the animal, the presence of edema about the nerve head was proved by microscopic examination. Neurologic symptoms appeared, their character depending on the area into which the agar capsule was inserted. In a second series of animals a generous, well-placed subtemporal decompression was performed before a similar capsule was introduced into the cerebral hemisphere. In five of seven animals no papilledema followed the swelling of the agar. In two in which a much larger amount of agar was introduced, papilledema occurred in spite of the decompression. A similar result was noted when the agar capsule was introduced into the cerebellum to simulate a cerebellar tumor. In the presence of a decompression, no papilledema could be noted. In another series of animals in which the capsule was introduced into the cerebellum, a wide suboccipital craniectomy was simultaneously performed.

This procedure was as effective as subtemporal decompression in preventing the occurrence of a choked disk when an artificial cerebellar tumor mass was produced. The importance of the mechanical factor of increased intracranial pressure in the production of papilledema seems corroborated by these experiments.

GRANT, Philadelphia.

BLOOD CHANGES IN CONVULSIONS, ESPECIALLY IN EPILEPSY. O. WUTH, Bull. Johns Hopkins Hosp. **38**:389, 1926.

White cell counts, differential count, serum protein, nonprotein nitrogen, uric acid and creatinin tests were made repeatedly on patients with epilepsy, general paralysis, syphilis of the brain and cardiorenal disease during and following convulsions.

There are no charts. The author summarizes his work as follows: Patients with convulsive states in epilepsy and other "diseases" have been shown to present marked changes in the cellular and chemical blood constituents.

During convulsions, polymorphonuclear leukocytosis and eosinopenia are observed, with subsequent oscillations of the curve and definite decline to the normal individual level; the lymphocytes vary without any definite rule. Nonprotein nitrogen, uric acid, creatinine and serum protein show an increase during or shortly after convulsions.

Decrease of leukocytes and of serum protein content, combined with increase of the chemical blood constituents in status epilepticus, seems to be a bad prognostic symptom.

The changes are not always uniform in the same or in different persons; they are not specific for any disease; they are not specific for the convulsive reaction, as they may be found as the result of all physical exertion. To a certain degree, the changes run parallel with intensity of physical overactivity. The changes described can be regarded as a secondary phenomenon due to convulsions or physical exertion.

The theories regarding the etiology of epilepsy or the mechanism of the convulsive reaction which are based on the changes of the aforementioned blood constituents will have to be abandoned.

No conclusions can be drawn from the cell count or the changes of cellular elements as to the "epileptic" representing a certain type.

LYTTLE, New York.

THE RELATION OF STATE HOSPITAL CLINICS TO THE MENTAL HEALTH OF SCHOOL CHILDREN. WILLIAM A. HOWE, State Hosp. Quart. **10**:615 (Aug.) 1925.

Since the adoption of the state mandatory school medical inspection law, there has been a marked increase in the number of children found with disturbances of the nervous system. This law applies to approximately 800,000 children; the examination during the school year 1923-1924 showed an increase of 9,036 patients with disorders of the nervous system over those found during the school year 1915-1916. The author feels that many children with these diseases are still not recognized as such because medical examiners for the most part are unfamiliar with nervous and mental disorders. As a result, children are allowed to develop a true psychosis or psychoneurosis because the liability to those conditions has not been recognized.

It is suggested that responsibility for improving this situation rests with psychiatrists and particularly with the medical staffs of the state hospitals. The mental hygiene clinics already instituted are commended, but additional

measures are recommended: training in psychiatry for the medical profession in general; stimulation of interest in mental hygiene on the part of parents, teachers and other interested agencies. The latter might be accomplished by sending information to those interested and by establishing clinical centers at hospitals to which patients might be sent for diagnostic and directory purposes.

The fact that there are a large number of neurotic teachers is responsible for the requirement, beginning September 1, of a certificate of physical and mental health of all matriculants in the state normal schools.

PSYCHIATRIC EXAMINATION OF A CHILD. DIVISION ON PREVENTION OF DELINQUENCY OF THE NATIONAL COMMITTEE FOR MENTAL HYGIENE, State Hosp. Quart. **10**:628 (Aug.) 1925.

The success of a psychiatric examination of a child depends on the establishment of a proper frame of mind in the child, by disabusing his mind of any prejudice, intimidation or factors that would give rise to a defense reaction. Questioning that would give the impression of attempts to elicit confessions of the misbehavior or delinquencies should be avoided. The psychiatric significance of how the child feels about conditions to which he does not adjust, what elements in such situations affect him most and what responsibility he assumes for his difficulty, should be of most importance.

One of the important lines of inquiry is that into family relationships. Such conflicts as a divided household involving a question of the child's loyalty, a step-parent of whom he is jealous or with whom he is incompatible, the death or absence of a parent to which he cannot resign himself, siblings who are brighter or who he feels are more popular than he, are some of the many situations to be considered. School relationships are a second important field. Examination should reveal whether he likes school and for what reason he began to dislike it and what subjects he likes or dislikes. His attitude toward his teacher and classmates should be determined, whether he feels he is fairly treated and on whom he places the blame for his difficulties. His social relationships, his needs, abilities and aspirations are important, as well as the amount of recreation he gets and what substitutes he has adopted for the lacks in his environment. Is he a leader or does he feel inferior, and if inferior why does he feel so? The dream life is important, as the dreams give an insight into desires, fears and conflicts. The attitude toward the opposite sex and knowledge of sex matters should be investigated cautiously to avoid increasing interest or deepening a possible conflict.

During the examination, care should be taken to keep the child's confidence and to guard against his connecting the psychiatrist with any idea of punishment. Questionable points should not be taken for granted if the child refuses responsibility for delinquencies, but information should be received with judicial friendliness. It is necessary to grasp the child's point of view and enter into all his problems with a friendly and sympathetic manner. The summary should include the motivating mechanism, the degree of insight, resources for adjustment and remediable difficulties in the environment.

HOWARD, Milwaukee

EPIDEMIC ENCEPHALITIS ASSOCIATED WITH CONVULSIONS IN CHILDREN. FRANZ GLASER, Monatschr. f. Kinderh. **32**:289, 1926.

This is a review of the literature and a report of five cases seen during the epidemic of grip and encephalitis of 1921-1923. The children varied in age from 1 to 3 years. They formed a group entirely distinct from the other

patients seen at that time; they all showed a typical sleep syndrome associated with convulsions and other signs of meningeal irritation. In one child, the spinal fluid agglutinated the influenza bacillus. In two children, a permanent defect in the brain remained; in the remaining three, recovery was complete. The author believes that this combination of sleeping sickness symptomatology plus meningeal irritation has not been described previously.

ENCEPHALITIS IN CHILDHOOD. B. KEMKES and S. SAENGER, Monatschr. f. Kinderh. **32**:334, 1926.

This is a review of all the cases of encephalitis occurring in the University Children's Clinic during the years 1920-1926. In all, there were seventy-two cases, of which twelve were definitely epidemic encephalitis. The majority of the cases occurred during the first and second years. In the absence of any definite laboratory test the diagnoses were made from clinical observations. These were rather constant and consisted of (*a*) ganglionic symptoms, such as rigidity, atheotoid movements, choreiform activity, tremor and amyostatic syndrome; (*b*) desire to sleep and later disturbance in sleep; (*c*) paralyses of the muscles of the eyes; (*d*) changes in character, and (*e*) chronic recurring course.

While all these symptoms were not present in every case, they occurred in most, although at times the diagnosis was confusing. In one it was confused with brain tumor, and in another there was some difficulty in ruling out ordinary chorea.

Of the twelve patients, only three recovered. Three died, and the remainder progressed to the chronic state.

ENCEPHALITIS OF THE CHILD. SAENGER and KEMKES, Monatschr. f. Kinderh. **33**:127, 1926.

This is the conclusion of a study begun in a preceding issue. It is a report of ten cases of encephalitis following acute infectious disease. Of these ten, one followed measles, three whooping cough, two paratyphoid and four pneumonia.

The results of the spinal fluid examination were interesting. In many cases there was no change. Cell increase in the spinal fluid was by no means dependent on the severity of the symptoms but rather was related to the age of the child. The majority of children showing cell increase were under 2 years of age. Possibly this is due to an increase in capillary permeability in infancy. The cells found were chiefly lymphocytes though a polymorphonuclear increase is not incompatible with the disease.

HEART INVOLVEMENT IN SPASMOPHILIA. OTTO CORSDRESS, Monatschr. f. Kinderh. **33**:137, 1926.

The author reviews the literature on sudden death in tetany in infants, showing that the majority of writers believe that this is due to heart involvemen and not to asphyxia. He then describes a case in which during an attack the heart action became so violent that it was almost like that of the heart seen through a fluoroscope. Electrocardiographic tracings were made on the infant, and, reasoning from this case and another one described by Schwenke, Corsdress believes that there are two types of cardiac involvement in spasmophilia, one associated with a hyperirritability of the accelerators and the other with irritability of the vagus. The treatment must take the two types into consideration.

THERAPEUTIC EXPERIMENTS WITH SPASMOPHILIA. KATE FUERST, Monatschr. f. Kinderh. **33**:399, 1926.

Neither insulin nor treatment with the quartz lamp had much effect on the alkali reserve. Fuerst believes, however, that the quartz light is of value in the treatment.

GERSTLEY, Chicago.

TERATOMA OF BRAIN. G. L. DERMAN, Virchows Arch. f. path. Anat. **259**:767, 1926.

In a teratoma of the brain of a month-old child, Derman found epithelium of various types, cuboidal, cylindric, pigmented and squamous. Cartilage, bone and striated muscle were also present.

O. T. SCHULTZ.

Diseases of the Eye

IMMUNIZATION OF THE CORNEA WITH STERILIZED LYMPH. KATHERINE LURIY, Monatschr. f. Kinderh. **33**:391, 1926.

The writer found that repeated vaccination of the cornea of rabbits with lymph heated to 56 C. did not confer any immunity to subsequent vaccination with active lymph. It did, however, create a state of allergy.

GERSTLEY, Chicago.

Diseases of the Ear, Nose and Throat

POSTADENOIDAL SPEECH. JOHN A. GLASSBURG, Arch. Otolaryng. **4**:296 (Oct.) 1926.

Normally, the uvula and soft palate close the nasopharyngeal space in the phonation of the nasal sounds. Huge adenoids produce a compensatory hypertrophy of this space. After adenoidectomy the space may be too wide to be bridged by the soft palate and uvula. Hypernasal speech defect results; this is usually temporary, but may be permanent. The treatment recommended is (1) prophylactic preoperative examination with regard to shortness of the soft palate; (2) electricity and massage (which are not practical), and (3) special exercises of the uvula, palate, tongue and lips. The exercises advised are listed.

ZYGOMATIC MASTOIDITIS WITHOUT CLINICAL OTITIS MEDIA. M. L. Breitstein, Arch. Otolaryng. **4**:300 (Oct.) 1926.

Zygomatic mastoiditis is a part of a widespread mastoid infection. Mastoiditis is usually associated with otitis media, but in exceptional cases, such as the one reported, there may be no evident middle ear involvement. This occurs in less than 4 per cent of mastoid conditions, and chiefly in girls under 10 years of age. In children, it is due to exceptional drainage facility of the short, wide eustachian tube, which permits clearing of the middle ear, while pus is walled back in the mastoid by swelling of the mucous membrane lining the connection with the antrum.

A case is reported of a girl, aged 6 years, with a circumscribed, nonfluctuating, tender, painful swelling over the right zygoma and without evident otitis media. The following day the swelling had extended to the mastoid region. Mastoidectomy revealed hemorrhagic involvement of the posterior mastoid cells with sequestrum formation and with frank pus in the zygomatic cells. Complete recovery followed the exenteration of all cells.

GIBSON, Chicago.

Sinus Thrombosis with General Sepsis in a Child with Recovery. Kurt Ochsenius and Viktor Sonnenkalb, Monatschr. f. Kinderh. **32**:530, 1926.

Following otitis media, the child developed sinus thrombosis without mastoid involvement. The operation later was complicated by pulmonary and pleural involvement. Besides a surgical operation, the only treatment was that of giving injections of the child's own blood. The strong constitution of the patient was a powerful factor in aiding the recovery.

Sinusitis in Infancy. Paul Kahn, Monatschr. f. Kinderh. **33**:12, 1926.

In this report of five cases of sinus disease occurring in infants, the symptoms were all alike, that is, one-sided purulent nasal discharge and later signs of the spreading of the process, such as edema of the eyelids, redness and blueness chiefly of the upper lid not involving the conjunctiva, and protrusion of the eyeball. Only one eye is usually involved, and this is held closed. The patients treated conservatively, that is, with hot dressings and nasal irrigation, made better recoveries than those on whom an operation was performed.

Gerstley, Chicago.

Diseases of the Skin

Dermatitis in the Diaper Region in Infants (Jacquet Dermatitis). J. V. Cook, Arch. Dermat. & Syph. **14**:539 (Nov.) 1926.

Diaper dermatitis is caused by ammonia liberated from the urea of the urine in the diaper by *Bacillus ammoniagenes*, which is frequently demonstrable in infants' feces. Hence, it is a dermatitis venenata. Protein content of the food, as well as the length of time the wet diaper is left in situ, influences the amount of ammonia liberated.

The skin lesions are (1) erythematous and (2) papulovesicular. The former vary from a mild redness to a deep red, edematous, locally hot area; the latter are rounded or oval, raised, red or bluish-red papules which may be eroded and vesicular or, in neglected cases, ulcerated. These must be differentiated from syphilids.

Treatment consists of rinsing the diapers, after they are clean, in a solution of mercuric chloride, 1:4,000, wringing them well and allowing them to dry. This prevents bacterial growth. A saturated solution of boric acid is the only other available antiseptic and is used similarly, though it is much less efficacious. Local treatment is necessary in only the severe forms and consists of applications of Lassar's paste or balsam of Peru, 4 per cent.

Barnett, Chicago.

Etiology of Erythema Nodosum. Karl Kundratitz, Jahrb. f. Kinderh. **113**: 153-183 (July) 1926.

The author has examined eighty-one patients with erythema nodosum in the Mautner Markhof Children's Hospital. Forty-two of these were boys; thirty-nine were girls. In seventy-seven the Pirquet test was positive; only four gave a negative Pirquet reaction, but these four had positive reactions with intracutaneous tuberculin 1:1,000. Most of these patients had intense reactions, with vesiculation. A majority had a history of tuberculosis in the family; in others there was a definite tuberculous process previously.

Prodromal symptoms before the eruption were fever lasting for several days, weakness, irregular pains and cough. Clinically, there were few tangible symptoms of organic tuberculosis. In most cases there were enlarged hilum lymph glands, and in individual cases there were primary lung lesions. Kundratitz believes from his observations that erythema nodosum and tuberculosis are closely associated, for all patients gave positive tuberculin reactions, even infants in whom the tuberculin test is negative ordinarily, and in children in whom the erythema nodosum was the first and only symptom of a tuberculous process. He cites one case in which the tuberculin test was negative previous to the eruption, but became positive with the appearance of the eruption. In another case following erythema nodosum, the child developed measles, after which it developed interlobar pleurisy and another eruption of erythema nodosum with a phlyctenular conjunctivitis. Measles is known to produce an anergy for tuberculosis, and is often followed by a tuberculous process. Three patients developed erythema nodosum during tuberculin treatments.

The author thinks that negative tuberculin reactions may be due either to variations in the tuberculin used for testing or to a negative phase in which the patient does not react to tuberculin, such as is seen after tuberculin treatment. A negative reaction may also occur in the body as an autotuberculin reaction. He has not found tubercle bacilli in the lesions but in one case, following the Pirquet test, many nodules were found about the lesion.

He has taken serum from bullae made by applying a cantharidin plaster over the lesions, and made a Pirquet test with it in ten cases by combining it with tuberculin. These tests produced much greater reactions than those made by the tuberculin alone, which were used as control tests. This he thinks substantiates further his idea that erythema nodosum is a tuberculous process, probably an autotuberculin reaction and not due to the organisms themselves.

EHRMANN, Chicago.

DERMOGRAPHY IN THE NEW-BORN AND NURSLINGS. KOICHI YAMAGISHI, J. Pediat. (Tokyo), Jan. 20, 1926, vol. 1.

Yamagishi observed the nature of dermography in 407 infants and nurslings in the Pediatric Clinic of Keio Medical College. He finds that strong and positive dermography is obtainable in new-born infants a few hours after birth, and that the degree of reaction is directly proportionate to the nutrition of infants. The reaction appears most pronounced during the days of initial loss of weight; that is, during the third and fifth days after birth. The forehead reaction is seen oftenest in well nourished infants. In premature and atrophic infants, the reaction is weak. The physiologic dermography gradually weakens as the nurslings grow older. Thus it appears that the nutritional state of a given infant has a definite relation to the degree of dermographic reactions. The reaction is not necessarily positive in meningitis and in infants with exudative diathesis. Negative forehead dermography is weak in the newborn and is still weaker at from 2 to 3 months, but gradually becomes strong in the last half of the first year. Dermography is definitely influenced by external stimuli. As dermographic reaction changes with the age of the infant, the examination of the reaction reveals the age of the infant in question. As a rule, a strong dermography indicates good health.

KATO, Los Angeles.

Surgery and Orthopedics

GIANT CELL TUMOR OF MIDDLE THIRD OF SHAFT OF FIBULA. B. R. KIRKLIN and W. D. GATCH, Am. J. Roentgenol. **14**:521 (Dec.) 1925.

The authors present this case because of the rarity of giant cell tumors of the shaft of the long bones. A boy, aged 4½, developed a tender swelling of the left fibula six months after a kick. The day before examination he complained of pain, and was unable to walk after a fall without gross injury. Roentgenologically, there was a cystlike expansion of the shaft of the left fibula, with a thin cortex and a pathologic fracture through it. Microscopically, there were areas of cells similar to fibroblasts with scattered giant cells with from 2 to 15 nuclei, and large mononuclear cells. The diagnosis was benign giant cell tumor of the shaft of the fibula, differing from the typical lesion by not being in the end of the long bone.

STULIK, Chicago.

THE EXPERIMENTAL PRODUCTION OF ABSCESS OF THE LUNG. E. C. CUTLER and S. A. SCHLEUTER, Ann. Surg. **84**:256 (Aug.) 1926.

In spite of the fact that the occurrence of postoperative lung abscess for a long time has been considered the result of the direct aspiration of infected material from the mouth, no one has been able as yet to reproduce this condition successfully in animals. All attempts to convey infected material into the lungs by way of the bronchial passages have thus far been a failure. Clinical evidence, also, would seem to disprove this theory. In the first place, postoperative lung abscess is not peculiar to tonsillectomy but when it is a sequel may occur as well after a local as a general anesthetic. Secondly, there frequently is a period of normal convalescence after operation lasting from seven to fourteen days before signs of pulmonary disease are manifest. Thirdly, there is ample clinical evidence to show that the endobronchial apparatus is well adapted for defense against infection.

The authors endeavored, therefore, to produce experimentally true lung abscesses on the theory that they were embolic in origin. In the early experiments, pieces of infected material were set free directly in the jugular vein of dogs, with the result that a fatal general diffuse pneumonitis was produced. In the later experiments, a local immunity was produced by enclosing the virulent organisms within sections of vein which after being ligated at either end were inserted into the femoral or jugular veins. The destination of the embolus could be followed easily with the roentgen ray because of the small bits of lead filings which were included within the mass of organisms. In 60 per cent of these animals the embolus lodged in the left lower lobe, the result, the authors believe, of the straighter course of the vessel and the greater volume of blood to that lobe in the dog. This could be analogous for the same reason to the right lower lobe in man which, as is commonly known, is the most frequent site for postoperative lung abscess.

The authors also report progress in experiments designed to determine the rôle of local immunity in the production of lung abscess. Their work thus far would seem to indicate that, when no immunity has been established previously, virulent clots set free in the venous circulation will result almost invariably in fatal pneumonitis, whereas when some degree of immunity has been established either by injection of nonvirulent organisms or by operations in fields in which organisms normally exist, such as the intestinal tract, the suppurative process set up by infected emboli may remain localized.

MILLER, Chicago.

MECKEL'S DIVERTICULUM: METHODS OF RESECTION. R. M. HARBIN, Surg. Gynec. Obst. **43**:515 (Oct.) 1926.

In a series of 2,624 abdominal operations, the incidence of Meckel's diverticulum was noted thirteen times, without careful search in every case. In 507 consecutive laparotomies in which a search was practicable, diverticula of the ileum were seen seven times. Five of these were the cause of symptoms in 314 cases showing acute abdominal conditions.

It has been accepted that Meckel's diverticulum is present in about 2 per cent of all persons. As more than 1 per cent of routine laparotomies show diverticula which appear to be causing trouble, a systematic search seems important in all abdominal cases unless a definite contraindication exists.

One must keep in mind the fact that these embryonic defects in the small bowel after repair carry with them some degree of dysfunction because the walls that are brought together after removal of the diverticula share some of the lack of vitality that was present in the wall of the original pouch. This fact would be of little significance if all the diverticula were offshoots from the peripheral mesial line of arterial anastomosis, but the majority of them arise more or less laterally from the anterior wall of the ileum. Also, the mesial line of arterial anastomosis may vary greatly in its position, so that the ideal line for resection cannot always be determined. This avascular area is often the site for adhesions, and the indented kink that follows a resection may be favorable for development of mechanical obstruction.

It is the author's belief that postoperative treatment should be modified to meet the hazard of dysfunction, which may be followed by obstruction, by restricting the fluid intake by mouth and giving rectal infusions until the bowels have moved on the fourth day.

A series of thirteen cases are reported, the records of which may be summarized as follows:

1. The youngest patient was 3, the oldest, 36, and the average age, 22 years.

2. In ten cases (70 per cent), Meckel's diverticulum seemed to be causing symptoms.

3. The preoperative diagnosis of diverticulitis was recorded in only one case.

4. The diverticula seemed uniformly to be about from 14 to 16 inches (from 35 to 40 cm.) from the cecum.

5. As to site, four were peripheral and nine more or less lateral. Two were tubular, three blunt, five pedunculated and three undetermined.

6. Eleven were resected and two infolded. Two of the acute type required subsequent operation for acute obstruction, and one symptomless diverticulum was resected and required subsequent operation for chronic obstruction.

7. There were two deaths.

MILLER, Chicago.

THE RADIOLOGIC ASPECT OF CERTAIN FORMS OF OSTEOCHONDRITIS. COLIN MACDONALD, M. J. Australia **1**:423 (April 17) 1926.

This paper is a discussion of the radiographic diagnosis and differential diagnosis of various forms of osteochondritis, not dependent on tuberculosis and syphilis as etiologic factors.

These conditions are osteochondritis deformans, juveniles coxae or Perthés' disease, Kohler's and Schlatter's disease. They have their counterparts in other regions of the body, namely, osteochondritis of the spine or osteochondritis

deformans juveniles dorsi of which there are two types: Scheuermann's type, resembling Perthés' disease, and Calve's type, resembling Kohler's disease or osteochondritis of the tarsal-navicular joint.

Other forms of osteochondritis resembling Perthés' disease are those involving the heel, the base of the fifth metatarsal, the medial sesamoid of the great toe and the tibial tubercle of the tarsal-navicular bone. The latter form differs from Kohler's disease in which the entire bone is involved.

Osteochondritis dissecans is briefly discussed.

The author makes a plea for caution in the radiographic diagnosis of tuberculosis of developing bone, as it is in developing bone that the foregoing conditions occur.

BUHRMAN, Chicago.

PERTHÉS' DISEASE (MALUM COXAE JUVENILE). A DISCUSSION OF ETIOLOGY AND PATHOGENESIS. RICHARD RIPA and VLADIMIR MUSIL, Čas. lék. česk. **64:** 701 (May) 1925.

In this continuation of a previous article, the etiologic aspect is discussed from the standpoint of tuberculosis, syphilis, rachitis, internal secretion, infection, trauma and the congenital theory. The pathogenesis is discussed from the standpoint of the histologic observations. This takes up primary atrophy, arthritis deformans, osteomalacia, secondary necrosis and secondary bone proliferation. The authors come to the conclusion that the disease is the result of poor nutrition of the epiphysis possibly due to a mixed etiology, which interferes with the circulation sufficiently to produce necrosis of the head of the femur. It is therefore a typical reaction of the juvenile epiphysis to nutritional disturbances and cannot be regarded as a disease *sui generis.* An extensive bibliography of 105 references is cited.

STULIK, Chicago.

Miscellaneous

A RATIONAL BASIS FOR VENTILATION. J. E. RUSH, J. Am. Soc. of Heating and Ventilating Engineers **32:**581, 1926.

Dr. Rush presents the problem of ventilation as one that must be solved in a measure by the physiologist and the physiologic chemist. He reviews the early studies in metabolism in which life processes were first compared to combustion, but shows that effects of poor ventilation are due primarily, not to a decrease in oxygen or an increase in carbon dioxide, but to an increase in temperature and humidity with lack of movement of the surrounding air. The body cannot rid itself of excessive heat by radiation, conduction or evaporation, and the result is a decrease in vasomotor tone with the accompanying well-known symptoms. Ventilation, then, is conceived of as a procedure for removing the excess heat and replacing it by fresh cool air. In such a consideration, the humidity is important; certain authorities state that it is desirable to have the dry bulb temperature between 56 and 60 F. and the wet bulb between 53 and 56 degrees.

Present methods of ventilation consist of uncontrolled ventilation, when one relies on windows for cooling and circulation, and controlled or artificial ventilation, when air is either forced into the rooms or exhausted from them or a combination of both. So far the evidence as to just what type of ventilation produces the best results is not conclusive. The author makes a plea for experimental work, not so much in the laboratory and calorimeter, but with

school and other populations when carefully controlled conditions of ventilation can exist.

The article considers many phases of the subject in detail, and is full of suggestions even for one who has little knowledge of medicine or engineering.

LESLIE, Chicago.

PROBLEMS OF DELINQUENCY AMONG GIRLS. KATE BURR JOHNSON, J. Soc. Hyg. **12**:385 (Oct.) 1926.

In girls, delinquency usually implies the sex offender. The distinction is based on the survival of a double standard of morality. Much of the present problem is due to the revolt of youth to the narrowness of view of the previous generation. The postwar period has not caused it but has exaggerated its manifestation. The final outcome may be the adoption of a sane and wholesome attitude toward the problem.

Our present misunderstanding and avoidance of these girls and their problems is forcing many to continue in a life of disrepute. Maternal affection is usually present in these girls and can be used in their rehabilitation, yet society makes it difficult for an unmarried mother to keep and rear her child. Forced marriage without love or respect is no true solution.

The author believes that, as a preliminary to facing the problem of sex delinquency, it will be necessary to substitute in ourselves a knowledge of the sociological and biologic aspects of sex for the emotional hypocrisy that now activates our attitudes. Then, through the agency of trained social workers, supplemented with care in appropriate institutions of those patients requiring extra efforts, the problem might well be controlled.

THE PUBLIC AND SOCIAL HYGIENE. VICTOR S. YARROWS, J. Soc. Hyg. **12**:398 (Oct.) 1926.

The author reviews briefly the modern theories concerning monogamy and its substitutes. He feels that these problems must be understood by those attempting to better social relations. It is necessary to view them not only from the point of view of biologic needs, but also from their psychologic and sociological aspects. The individual must be convinced that his happiness and complete development will be promoted by the course of conduct that society and the law prescribe for him. If this is done honestly, the present sex code of morals is secure.

HAPPINESS IN RELATION TO AGE AT MARRIAGE. HORNELL HART and WILMER SHIELDS, J. Soc. Hyg. **12**:403 (Oct.) 1926.

As a result of a statistical study of ages of couples at marriage and of cases in the courts of domestic relations and of divorce, the authors conclude that the age at marriage which involves the least hazard is 29 for the groom and 24 for the bride, with a deviation of four years on either side of these figures. They discuss possible fallacies in their conclusions.

BOYD, Iowa City.

BEE STING TREATMENT. W. RAY JONES, Northwest Med. **25**:557 (Oct.) 1926.

Bee poison contains two toxins, a powerful local irritant and a general systemic poison. The former is supposed to be formic acid. The general poisoning is similar to anaphylaxis, and is accompanied by a feeling of suffocation

and bursting and by subcutaneous hemorrhages. Braun prepared a standardized toxin by grinding the posterior eighth of a bee's abdomen in saline solution and giving desensitizing doses. Hypodermic administration of epinephrine hydrochloride corrects the general reaction and retards the local swelling but does not alleviate the pain of the sting. He says this use of epinephrine is well known to bee keepers but little known to physicians.

SCOTT, Philadelphia.

THE CHILDREN'S UNIT AT KING'S PARK STATE HOSPITAL. HARRIET A. ROBESON, State Hosp. Quart. **10**:578 (Aug.) 1925.

To obviate the unsatisfactory method of housing children in the same wards with adult patients, two cottages were opened for children under 16, one for boys and one for girls. The cottages were intended for children with all types of mental disease, and during the first year there were fifty-eight admissions. Forty-one of the patients had a history of epidemic encephalitis; the other seventeen included diagnoses of dementia praecox, manic-depressive psychosis, mental deficiency and brain tumor.

The cottages were cheerful and homelike, all guards being taken from the windows, etc. The problem at once resolved itself into one of emotional control and of retraining the children with a habit-training schedule. This schedule was a well balanced one of occupational therapy, academic work, personal toilet and play. After a trying initial period of adjustment, good results were slowly obtained. Physical improvement was prompt. Emotional instability, behavior disorders and pernicious sex habits responded more slowly but gratifyingly. The most favorable results were obtained in the behavior disorders following epidemic encephalitis. As a whole, the children responded better to academic work than to occupational therapy.

HOWARD, Milwaukee.

ALLERGIC DISEASES OF CHILDHOOD. GEORGE A. CAMPBELL, Canad. M. A. J. **16**: 1071 (Sept.) 1926.

This is a report of a study of seventy-seven children who presented symptoms of protein sensitization. The diagnosis was more or less accurate in fifty-seven cases; in twenty the diagnosis was not complete. The treatment was successful in five breast-fed infants who had eczema. It was successful in twenty-one of twenty-seven artificially fed infants who had eczema and unsuccessful in six. Of twelve patients with asthma, nine were relieved and three were not relieved; in three patients with combined asthma and eczema, the treatment was successful; in eleven of sixteen patients with chronic upper respiratory tract infection, treatment was successful and in five it was unsuccessful; four patients with hay-fever were cured. In one of three patients with cyclic vomiting, treatment was successful; in one of two patients with urticaria, treatment was successful. Five patients were thought to be allergic, but later it was proved that they were not.

The author stresses the importance of a careful history in a study of the cases. Case histories in the various groups are given in detail. The following conclusions are made:

1. Multiple sensitization to foreign proteins is the rule in allergic children.
2. Allergic heredity was found in 42 per cent of cases.
3. Eczema in breast-fed infants is more amenable to treatment than in any other allergic group.

4. Silk protein gave more positive reactions than any other protein found in clothing.

5. Desensitization should be begun with minute doses, otherwise fatal reactions may occur.

6. The results in urticaria and cyclic vomiting have been disappointing.

MOORE, Omaha.

HOMES FOR BABIES IN ALSACE-LORRAINE. MADAME VIVIER-ROBERT, Rev. internat. de l'enf. **1**:494 (June) 1926.

The system of providing wet nurses for foster children in France has languished, in spite of every effort to maintain it, largely through changed economic conditions following the war. More women are employed in the various industries than formerly, and the increased wages offered have attracted many who would, under other circumstances, have sought positions offered at the various homes for babies throughout the republic. This is true particularly of the districts mentioned in Madame Vivier's paper. She compares the situation here with that in Alsace and Lorraine, where these institutions are conducted more satisfactorily, and where the mortality is much lower than in similar homes in Paris. A considerable number of the infants are breast-fed, the wet nurses being recruited from the hospitals for unmarried mothers. Older babies are fed artificially, and the utmost care is employed to suit the alimentation of each child to its individual requirements. The mortality rates are surprisingly low at Metz, Strasbourg and Mulhouse.

AMESSE, Denver.

SIGNIFICANCE OF THE WHITE BLOOD COUNT IN THE INFANT AND IN THE CHILD. F. HEISSEN, Monatschr. f. Kinderh. **33**:225, 1926.

In a series of blood examinations performed on patients with varied ailments, the author finds that while blood counts are not of as great value in children as in adults, they do help to differentiate a number of conditions, such as typhoid fever, miliary tuberculosis and spesis. In typhoid fever he finds leukopenia with relative increase of lymphocytes. In miliary tuberculosis the leukopenia is associated with relative decrease of lymphocytes. In sepsis there is a leukocytosis.

CONCERNING INTRAPERITONEAL INFUSIONS. O. TEZNER and A. EBEL, Monatschr. f. Kinderh. **33**:294, 1926.

The writers discuss the subject of intraperitoneal injections and describe some work of their own. They took two groups of children, one with mild dystrophies but with no disturbance of water metabolism, and the other with disturbance of water metabolism. In each group they administered physiologic sodium chloride or 6 per cent glucose solution intraperitoneally. The results were different in each group. In the hydrostabile group the injections had no effect on the weight curve. The excess of water was excreted chiefly in the insensible perspiration and not by the kidneys. There was little difference between the physiologic sodium chloride and the glucose solutions, but the authors are inclined to prefer the glucose because of its caloric value and because it seemed less likely to produce edema.

In the sixty-seven severely sick children, the injections had real value and in four of these were actually life saving. The injection is not without danger,

however, for in two of the sixty-seven a sterile peritonitis was found at necropsy. The authors conclude that the intraperitoneal method is of great value, but that it is an heroic measure and should be undertaken only as a last resort.

GERSTLEY, Chicago.

EXPERIMENTAL STUDIES ON THE SUBARACHNOID INJECTION OF COLLOIDAL SILVER AS A THERAPEUTIC MEASURE. M. FUKUSHIMA, J. Pediat. (Tokyo), Jan. 20, 1926, p. 39.

The author endeavors to determine exactly to what factor is due the therapeutic effect of injections of colloidal silver preparations into the subarachnoid space in the treatment of various bacterial diseases. He injected 0.1 cc. of a colloidal suspension of silver into the subarachnoid space in rabbits, and frequent examination of the spinal fluid revealed the fact that the fluid became definitely turbid due to the presence of globulin and polymorphonuclear leukocytosis. Hydrogen ion concentration increases up to four hours after injection, and the increase in the sugar is greatest at twenty-four hours. Carbon dioxide combining power is slightly decreased or shows no change. As to the constitutional changes, the author notes that there is an elevation of body temperature and polymorphonuclear leukocytosis (pseudo-eosinophilia in rabbits). The injection exerts no changes on blood pressure and respiration.

KATO, Los Angeles.

Book Reviews

DIE HYGIENE DER MENSCHLICHEN FORTPFLANZUNG. VERSUCH EINER PRAKTISCHEN HYGIENIK. BY ALFRED GROTJAHN. Price, 15 marks (bound, 17.70). Pp. 344. Berlin: Urban & Schwarzenberg, 1926.

This is an attempt by the eminent professor of social hygiene of the university of Berlin to publish a practical book on eugenics. In this book he traces the problem from primitive people, the Asiatics, the old Greeks and Romans, to people of the present day. Malthus and the neomalthusians receive their due; the present status of eugenics is described, and its future tasks as a national and international problem are formulated. It is stated that the teachings of rational propagation should become independent of all superfluous botanical and zoological constituents and should employ the natural and social sciences, especially pathology of constitution, psychology, sociology, medical and economic statistics. Physical and mental health are determined by social factors, such as environment, diet, work and inherited characteristics. The last factor is hardest to influence. It is impossible to improve the progeny by improving the health and strength of the person. Only indirectly, by preventing or reducing the propagation of the weak and inferior and by encouraging the procreation of the strong and superior, can practical eugenics be carried out. There is an excellent chapter on birth control. In Grotjahn's opinion, the methods available at present are adequate to regulate procreation. He describes in detail those that he considers efficient.

The biology and pathology of heredity at present are not sufficient to serve as a basis for an effective practical hygiene of procreation. In relatively few cases can it be determined with certainty that certain persons should not have offspring.

A chapter is devoted to the falling off of the birth rate. The war alone cannot be held responsible, as there is a falling off to be noted in neutral countries also. Great emphasis is laid on the menace of the "two children rule." It has been proved that in order to maintain a population at its present level, each married couple must rear at least three children beyond the fifth year.

There is a comprehensive summary of terms and definitions in use in the study of heredity and eugenics. Hereditary taints Grotjahn would classify into manifest and veiled, and into the subgroups of unessential, essential but rare and essential and frequent. The list of unessential manifest taints includes forty-eight conditions, among them ptosis, nystagmus, malformations of fingers, harelip, migraine and freckles. Thirty-seven conditions, among them amaurotic family idiocy, hemophilia, ichthyosis, microcephaly, deafmutism, are essential but rare taints. It is pointed out that the exclusion of persons so tainted would not be sufficient to cause these conditions to disappear altogether. There still would be a number who might carry these taints as recessive characters. The exclusion, however, of persons with manifest essential rare taints and perhaps their parents and siblings would gradually lead to purification.

Veiled unessential taints, which may be neglected by practical eugenics, include arteriosclerosis and exudative diathesis.

Rare veiled essential taints are dipsomania, morphinomania, infantilism and others.

The most important frequent veiled taints are asthenic constitution, diabetic constitution, bisexuality, epilepsy, hypothyrotoxic constitution, psychopathic and imbecilic constitution.

But in excluding unfit persons from procreation, one must not lose sight of the fact that it is a most important task of eugenics to encourage the procreation of the fit. Skilfulness, beauty, endurance, altruism and will power are endowments to be encouraged. Persons unusually gifted in art, science and research not rarely belong to families having produced psychopathic persons. This is indeed a problem in eugenics. Grotjahn would compromise by excluding mentally inferior persons "with care" and not too thoroughly until the relationship is better understood. He recommends that those highly gifted should mate with the average, in order to lessen the danger of recessive characters becoming manifest in their children or grandchildren.

The tuberculous must not procreate. When it comes to finding a mate, those with diabetes, alcoholism and morphinism, those working excessively and in unprotected occupations using lead and roentgen rays and those permanently sojourning in tropical climates are no less to be avoided than those with venereal disease. Those with asthenic constitutions, and among them the person with a poor appetite, are subject to eugenic restraint. The pediatrician will testify that if these rules are rigidly carried out, America will soon be depopulated.

Persons who should be encouraged to propagate are those who by physical examination have been found fit to enter their professions, chief among them soldiers, policemen, miners and nurses.

A good deal of space is devoted to Grotjahn's scheme for bettering the economic condition of parents. He believes it to be the only means of combating the falling off of the birth rate. The income is to be commensurate with the number of children. And if the unmarried woman fares rather badly — even in comparison with the unmarried man — she may find consolation in the fact that her sister, the mother of six or more, is at last in a position to put her fertility on a paying basis.

Professional work of women has a dysgenic effect on propagation and should be limited to those especially gifted. The general tendency for the daughters of the intellectual middle classes to aspire to a higher education should be discouraged.

Forcible sterilization may be desirable in selected cases, but this is probably not the time to make it a state law. In the present state of knowledge, feeblemindedness and epilepsy are the only conditions justifying sterilization.

Grotjahn protests against euthanasia — helping the misformed and the idiots to die. He approves of the requirement of health certificates before marriage. He recommends stations for advice in sexual and especially in eugenic matters.

This is a decidedly interesting and essentially a sane book, and if some of the rules and statements seem arbitrary and most difficult to carry out, the reader who may fear that strict adherence to the rules might make the world a eugenically perfect, but a less beguiling place to live in, may be comforted by the thought that the goal is far off, human beings and their impulses being what they are.

GESCHLECHTSKRANKHEITEN BEI KINDERN. Edited by A. BUSCHKE and M. GUMPERT. Price, 5.40 marks. Pp. 108, with 10 illustrations. Berlin: Julius Springer, 1926.

This small book of 108 pages contains a collection of articles on venereal subjects by four different authors. The first half of the work is devoted to syphilis, gonorrhea and psychic anomalies in children; the second half to a lengthy discussion of the fight of society against venereal diseases, particularly in the young.

Syphilis in children is shortly but clearly reviewed by Martin Gumpert (Berlin). Both acquired and congenital forms are considered, mainly from the standpoint of symptoms, diagnosis and social relations. Treatment is given little space.

Gonorrhea in boys and girls is ably and conscientiously treated by Erich Langer (Berlin). The complications and metastatic infections, rectal gonorrhea, acuminate condylomas and chancroid also are described briefly.

Franz Kramer (Berlin) writes six pages on the relationship of venereal diseases, mostly syphilis, to psychic anomalies in children. He says that from 10 to 15 per cent of cases of feeblemindedness in children are due to syphilis. Besides the psychopathic states he mentions hydrocephalus, microcephalus, progressive paralysis and other diseases of the central nervous system as results of syphilis.

The chief criticism of the first half of the book is the compendium-like brevity employed in the handling of this quick review of syphilis and gonorrhea.

Slightly more than half the work is given over to a discussion of the fight of society against venereal diseases in children, before and after infection, by Werner Fischer-Defoy (Frankfurt am Main). The many aspects of this subject are freely, wisely and fully discussed. He lays stress on the early discovery, proper treatment and a knowledge of the many modes of infection. The brunt of the fight he frankly puts up to the local and general governments, and to physicians and organizations. He makes a strong plea for clean education, right living and abstinence from alcohol and modernism in the youth of today.

This book is short, concise, and, in its way, laudable, particularly the second half, which may have considerable value for both the physician and the layman.

DIAGNOSTIK UND THERAPIE DER KINDERKRANKHEITEN. By DR. F. LUST. Price, unbound, 10.50 marks, bound, 12 marks. Berlin: Urban & Schwarzenberg, 1926.

This practical guide or handbook for the practitioner is far more complete and elaborate than many similar texts which have appeared recently. Every field in the pediatric domain is covered, and, if not described in detail, at least is briefly and tersely mentioned.

The greatest possible emphasis is laid on diagnosis and therapy, the former particularly if it concerns conditions fairly rare or peculiarly germane to pediatrics. In the field of therapy, the book excels. In keeping with this arrangement, the author has added a most complete compendium of useful drugs and prescriptions, and minute and detailed directions for all kinds of therapeutic procedure. This is a distinct departure from the usual in texts of this kind, but is the type of information welcomed more than any other by the busy practitioner.

The chapter on artificial feeding is inadequate both as regards specific indications for the use of various foods and food mixtures and detailed directions for their preparation. The chapters on constitutional diathesis and on rickets are good. The chapters on the gastro-intestinal disorders are among the best in the book, and abound in useful therapeutic suggestions. In contrast is the rather superficial discussion of some of the diseases of the urogenital apparatus, notably pyelocystitis. The chapters on the infectious diseases are good, and are as complete as one finds them in larger and more comprehensive texts.

The section on drug therapy has the disadvantage so common to present-day continental pharmacology—drugs are commonly mentioned only under trade names. To many readers, these will be entirely unfamiliar and therefore meaningless.

The popularity of this text is attested by the fact that it has already passed through four editions.